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ENGINEERING AND MINING JOURNAL

METAL AND NON-METALLIC MINING · MILLING · SMELTING · REFINING · MARKETING

McGRAW-HILL PUBLISHING COMPANY, INC. September 22, 1928 TWENTY-FIVE CENTS PER COPY

Treating Old Gold-Silver Tailings By Modern Methods

By E. S. Leaver and J. A. Woolf

Diamond Drilling Practice At the Britannia Mines

By Frank Ebbutt

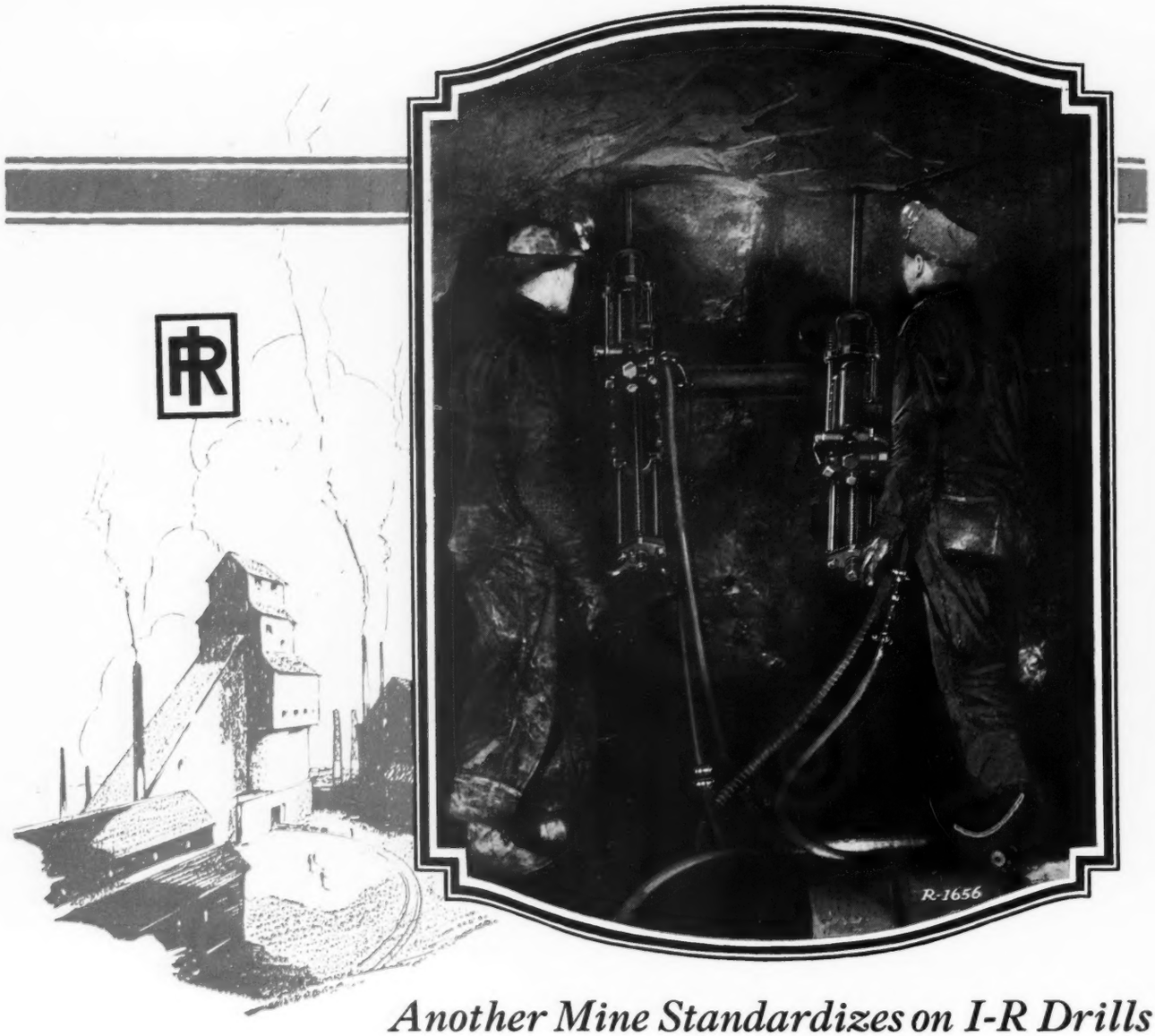
Solving Early Problems of the Noranda Smelter

By A. H. Hubbell

Development of Flotation At Broken Hill

By E. J. Horwood

Reminiscences of John Hays Hammond



Another Mine Standardizes on I-R Drills

Other Ingersoll-Rand machinery at the Tamarack mine includes air compressors, drill steel sharpeners, drill steel, and pumps..

The Tamarack and Custer Mine at Wallace, Idaho, is another property that depends entirely on Ingersoll-Rand drills.

Many years ago, the management decided to standardize on one make of drill. Thorough tests were conducted, and these resulted in the selection of I-R machines.

The wisdom of their selection has been verified by the continued use of I-R machines and the great progress made.

Old machines have been replaced and new machines added since the Tamarack and Custer first standardized on the one make, but always the new machines have been I-R.

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The Gospel of "It Can Be Done"

IT HAS been said that no citadel can be taken by a general who believes that "it can't be done." In the ordinary affairs of life, whenever a proposal invites difficulty in achievement, the crape hanger appears. It hasn't been done, he proclaims, and therefore it can't be done. Of such material is constructed the greatest stumbling block to progress, because fear of failure is suggested to all engaged in research.

Engineering and Mining Journal has no desire to appear to minimize the importance of caution, but sometimes we believe that it would be as well if the pessimists and wet blanketers looked backward as well as forward. They might then realize that most great reforms and the majority of outstanding achievements have come about in the face of persistent derision from adherents of the it-can't-be-done gospel. Let us recall, for instance, that less than two decades ago the greatest copper mine in the world was a mountain of discolored stone, assessed as almost valueless by those whose vision was limited to small-scale operations, who lacked imagination as to the inevitable march of progress in mining and metallurgical methods.

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Permanent Protection

THE only permanent protection the coils of a motor have against destruction from acids, alkalis, metallic dust, and the clogging of air passages, is to seal them against contact.

Allis-Chalmers Manufacturing Company has developed a new type of motor wherein this protection is accomplished without appreciable increase in weight or mounting space over the standard open type motor.

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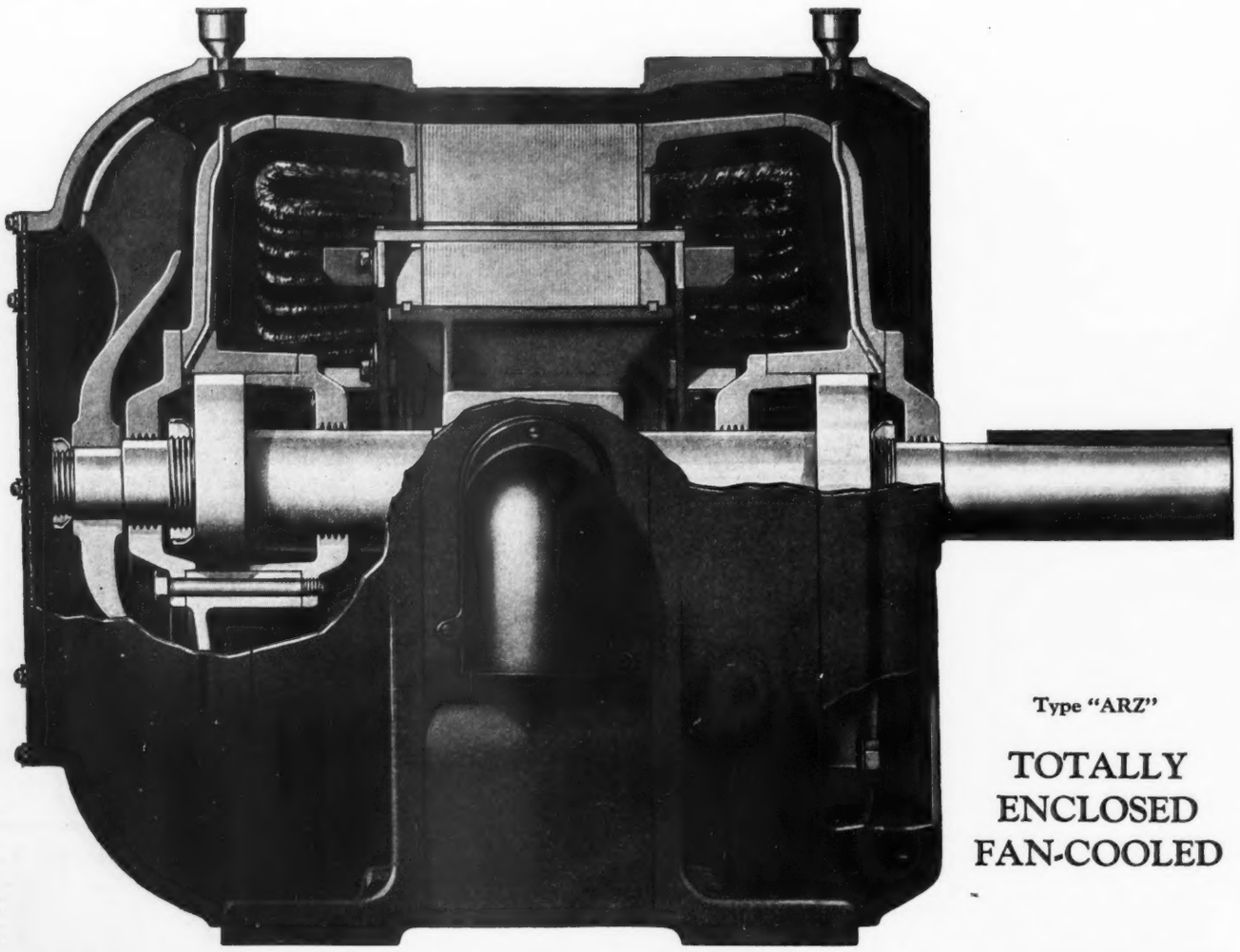

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ALLIS-CHALMERS MOTORS

ENGINEERING AND
MINING JOURNAL

McGraw-Hill Publishing Company, Inc.
JAMES H. MCGRAW, *President*

A. W. ALLEN,
Editor

VOLUME 126 — *New York, September 22, 1928* — NUMBER 12

Prosperity Follows When Best Practice Becomes Common Practice

DURING a survey to determine factors affecting and reasons for the growth of wealth in the United States, Dr. Hollis Godfrey, president of Engineering-Economics Foundation, discovered the importance of what is generally known as the "trade" paper as a transmitter of ideas to industries and professions. In this relaying of organized knowledge the technical and engineering press ranks high, if not highest, in all the branches of journalistic endeavor.

It is not commonly recognized that the technical magazine is the only agency that takes an idea from its industry and interprets it for the benefit of a wider audience, if necessary; makes that idea available and intelligible to vast numbers in that industry, instead of only to a few specialists; "dresses up" the idea so that even the busy executive and the tired worker can grasp its importance in the minimum of time and with the least mental effort. In other words, it is the function of the "trade" paper, as the official transmitter of organized knowledge at frequent intervals, to take the best practice, as determined by science and art, and to make every endeavor by editorial influence to broadcast it far and wide, and to make it the common practice of the whole industry.

Dr. Godfrey's researches have shown unmistakably that the growth of wealth in the United States has synpersisted are deserving of the greatest share of credit, virile technical press. The pioneer journals that have persisted are deserving of the greatest share of credit, in having made the largest contribution to progress. The influence of a single copy of *Engineering and Mining Journal* fades into insignificance when it is recalled that about 3,250 weekly issues have appeared to date; and although the ideal of performance and service is not yet in sight, yet the aim is high and steady progress is being made.

A recent correspondent, who shrank from publicity, told us he considered that the claim made by *Engineering and Mining Journal* as to the accuracy of its metal-market reports was an example of "New York bombast." Comments of this character engender a feeling of deep concern for the mental attitude of those who refuse to investigate or to accept facts. The alternative to claiming credit when credit is due is a slippage into obscurity; and no good to the industry as a whole would result from the propaganda and practices of those who take unfair advantage of such an attitude. *Engineering and Mining Journal* has played and is playing a significant part in the marketing of the products of the industry it represents.

Moreover, it were futile to discuss whether *Engineering and Mining Journal* is primarily a trade paper, a business paper, a professional paper, a mixture of any two of these, or a combination of all three. To those of our critics who are inclined to complain at times that it is not 100 per cent professional—whatever that means in the conduct of any non-philanthropic or non-subsidized enterprise—one might point out that its ability to serve is limited in large measure to the income received from advertisers who are inventors and developers and manufacturers of the equipment that plays so essential a part in the successful functioning of any techno-engineering enterprise. To ignore this fact and at the same time to share in the benefits that accrue to the industry as a whole as a result of the dissemination of worth-while information, whereby best practice becomes common practice, is merely an example of intellectual dishonesty. The independent technical press deserves the full support of the industry it represents.

New Electrolytic Zinc Plant Planned for Mid-West

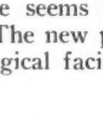
ANNOUNCEMENT that the Evans-Wallower Lead Company is to build a fifty-ton electrolytic zinc plant at St. Louis is no surprise, for there is an increasing world trend toward the production of zinc by electrolytic methods, and the building of a plant in the Mississippi valley is not a new idea. Some time ago there were rumors that such an installation would be made in the Tri-State mining district, competing with the retort smelters and handling the same class of high-grade concentrates. That it has never been built is attributable to the fact that there is already more than adequate smelting capacity to take care of the Tri-State mine output, and apparently the cost advantage claimed in favor of electrolytic production over retort smelting is not sufficiently alluring. The Evans-Wallower plant, it is reported, will treat concentrate made from low-grade western ores, with their valuable by-products, rather than the 60 per cent Joplin product, though mention is made of the possibility of treating the last named in periods of over-production. Evidently, it has been calculated that the freight charges from western concentrators will be partly offset by the fact that a good market exists for sulphuric acid, a chemical company being "next door." Also, a favorable power contract must have been made, for power is an important item in electrolytic work.

The cost of the plant, stated to be approximately a million dollars, is reasonable for a fifty-ton Tainton electrolytic unit. The cost of the Sullivan plant, using the same process, has not been published, but it was expected

to be from one-and-a-quarter to one-and-a-half million dollars. Money can be saved in the newer plant by following precedent as well as by heeding experience. Interest and depreciation are big factors in the cost of electrolytic zinc, the actual operating cost per pound produced probably not being greatly different whether the metal is made by retorting or by electrolytic means. A fair guess would be about two cents per pound by either method, neglecting credits for byproducts, though where electric power is cheap, as at Trail for example, the cost doubtless approaches one cent per pound.

Without any direct knowledge of conditions obtaining at St. Louis, a guess might be made that coal-generated power would not cost over $40 per horsepower-year. If Tri-State concentrates were used, high in grade, with only six to eight per cent "insoluble" and practically no iron, the operating cost should not be greatly over one and a half cents per pound, though this sum would be appreciably increased if lower-grade concentrate from complex ore were used. Then, too, the question of byproducts complicates calculations. Electrolytic zinc, of course, brings a better price than does Prime Western grade, perhaps close to a cent more per pound; but, as the higher-grade product becomes increasingly plentiful, it is altogether likely that the differential will lessen.

The directors of the Evans-Wallower company are to be congratulated on their initiative; there seems little likelihood that they will regret the step. The new plant will be a welcome addition to the metallurgical facilities already existing in the United States.



The Sintering Inventions and Patent Law Interpretation

A RECENT decision of the U. S. Circuit Court of Appeals confirms the decree issued last year by the U. S. District Court dismissing the complaint of the Dwight & Lloyd Sintering Company against Mr. John E. Greenawalt, *et al.*, and a counterclaim, in regard to basic and supplementary patents on the sintering of ores. The outcome is of considerable interest, if only as illustrative of the pitfalls and complexities of patenting as an adjunct to business.

In this particular case the decision sets aside the basic Dwight patent on the ground of laches—undue delay in asserting a right—the Court maintaining that "To allow them [the Dwight & Lloyd Company] to hold in reserve this patent appears to us to invite just those delays which are so oppressive an incident to patent suits. If we are to recognize such an excuse, we weave one more thread in the mesh which entangles those who must pass through their mazes." Justice D. J. Thacher, in the original decision, affirmed that "Assuming infringement, I am entirely satisfied that Greenawalt honestly believed he was not infringing. This belief was confirmed and encouraged by the plaintiff's acquiescence, with full knowledge and without objection, in all that he did."

The Court, in discussing the Dwight sintering pan patent, goes into minute technicalities, maintaining its invalidity if infringed. The decision in regard to the "iron" patent maintains that "The process apparently appears to us completely anticipated by Heberlein's patent, 844,355 . . . The merit of the invention [Dwight's] is its avoidance of silicates; it does not appear that merely to use carbonaceous material when the ores did not contain their own combustible proved a great step in the art." The claims were therefore considered as having been anticipated. The Court, in discussing the various ignition patents of Dwight, invalidated claims that cover an invention of Greenawalt in prior public use.

No disinterested observer can wade through the maze of technicalities incidental to such trials without a feeling of regret that co-operation and arbitration cannot be resorted to in place of legal action, which invariably broadens rather than narrows the rift between inventors. This is especially true when the technicians on both sides are true inventors and have shown diligence and zeal in their contributions to the upbuilding of the art. The conclusion is inescapable that many patent fights are engineered and fostered by the legal fraternity.

Butte Copper Consolidated— Is It a Good Mine?

NUMEROUS correspondents have written asking about the Butte Copper Consolidated Mines Company. To quote from one typical letter: "I hope you will be so kind as to let me know if this mine is any good, or if the future prospects are bright." We cannot answer that question categorically; nor can anyone say that the outlook is good or bad with assurance. If the most competent and most impartial engineer that could be selected should examine the property tomorrow he could not properly say that the mine might not in the next ten years produce ore worth $50,000,000 and pay $10,000,000 in dividends. The reason is that he cannot see into the ground. And for the same reason it is ridiculous for the optimistic gentleman who is quoted in the *Financialistic Debater,* of Boston, to make an "estimate" of $10,000,000 as the value of the mine.

The facts regarding the property appear to be as follows: The Radersburg district, about 20 miles east of Butte, Mont., has produced lead-silver ore from comparatively shallow workings in the past; surface indications and the regional geology are not unfavorable, and well-known engineers have recognized the possibility of developing at least small mines. About a year ago Butte Copper Consolidated acquired control of the Joe Dandy mine and started deepening a shaft that already was several hundred feet down. In July, 1928, workings on the 400 level penetrated a chimney of rich lead-silver ore, and during the last two months about 20 car loads of ore have been hauled to the railroad, 15 miles away, and shipped to the Helena smelter of American Smelting & Refining. One car of 29 tons averaged 67 per cent lead and 26 ounces silver; others returned from 20 per cent lead, upward. In all, net smelter returns had totaled about $25,000 up to the first week in September. A new hoist and other equipment are being installed with the object of working to a depth of 800 feet. Regarding the accuracy of the foregoing there is no doubt.

How big the first orebody encountered may prove to be; how many more orebodies may be found, and how big and how rich they may prove to be—these are questions that no one can answer. It is certain that the time elapsed since ore was first found has been too short to

permit the doing of development work necessary to prove much about the future prospects of the property. In some respects the deposits seem to resemble those of Ahumada and Erupcion, in northern Mexico. They are chimneys of rich ore that occur where they occur; that is to say, without any recognizable system or uniformity. Several competent engineers "turned down" Ahumada and Erupcion in the early days; others recommended development and, as it turned out, the two mines produced to the end of 1927, 250,000,000 pounds of lead and 3,000,000 ounces of silver. Between $4,000,000 and $5,000,000 in dividends was paid. The point to be made is that none of the various sets of engineers could anticipate what development would disclose. One advised spending money to explore or prospect, and subsequent events proved that the advice was good.

Now to give, or rather to dodge, a direct answer to our correspondent's question: The Joe Dandy mine has produced some rich ore; it may produce a great deal more. On the other hand, it is possible that the 20 cars already shipped or the first 100 cars will exhaust the known orebody and that no other will be found. The engineer quoted by the *Financialistic Debater* talks of the quantity of ore down to 2,500 feet, whereas the deepest workings are only 400 feet or thereabouts. He also prophesies that the ore at greater depth will assay 200 ounces per ton in silver, whereas the present ore averages about 25 ounces. These statements in themselves destroy confidence in the value of the judgment or expressed opinion of this individual. They arouse suspicion in the mind of any mining engineer and tend to discredit the entire enterprise. And yet, as has been said, no one has knowledge on which to base an assertion that the Joe Dandy may not become a wonderful mine.

Smelter Slag as a Useful Byproduct

COMMENCEMENT of construction work at Globe, Ariz., on a plant for the utilization of smelter slag from the furnaces of the Old Dominion Company draws attention to possibilities in the utilization of a waste material. Reports affirm that the Slag Paving Brick & Products Company at Globe, which has contracted for 60 per cent of the slag from the Old Dominion smelter at ten cents per ton, will manufacture sundry construction products, based on proposals made by Mr. Charles T. Bray. These involve the remelting of the dump slag. It seems a pity that the heat already in the slag cannot be utilized and the object molded and annealed direct. The time may not be far distant when the heat in all slag will be utilized. An interchange of views on this subject would be welcome.

Waste slag has been used extensively in this country as railroad ballast and as a constituent of concrete in instances where weight is immaterial, and in smaller quantities for the manufacture of slag wool. Slag brick made in England may be seen in the streets of Washington, D. C., their durability being due to adequate annealing after molding—a requirement too often disregarded by investigators into the possible use of slag in the United States, but apparently recognized in the plans now reaching consummation at Globe.

Tests made by the Office of Roads and Rural Engineering on smelter slag, as obtained from various dumps, indicate that even after quick cooling it is hard and tough. After a scientific but not expensive annealing process it should prove unusually resistant and suitable for many useful purposes.

Opportunity Beckons from Japan to the Mining Engineer

NO LESS an authority than the New York *Times* reports a project to construct in Tokio, Japan, a building eighty stories deep! The scheme is to excavate a hole 1,100 feet deep and 155 feet in diameter, and in this cavern to erect a modern building. A central well, 75 feet in diameter, is to be left for ventilation and lighting. The building, according to the story, is to be equipped with electric lights, telephones, radios, elevators and "sunlight reflecting mirrors." No mention is made of barber shops and cafeterias in the basement, but probably they will be there.

The ostensible purpose of sinking this "skyscraper" is to avoid possible catastrophe as the result of earthquakes —a sensible procedure, one would say, at least at first thought. If the plan be carried out, broad opportunity arises for mining engineers and manufacturers of mining equipment. About 1,000,000 tons of rock must be removed, equivalent to about six months' production by Calumet & Hecla Consolidated in Michigan. Equipment and supplies for drilling and blasting, loading and hoisting would be required. The selection of the best method of mining would be an interesting problem. Excavating a big open cut would be slow and costly. Perhaps the best way would be to sink two shafts, connect them with laterals at various levels, and stope overhand in, say, 100-foot lifts. Determining the details of procedure would provide a nice task for a mining engineer.

Another problem would be that of ventilation. As the need for positive circulation of air by mechanical means is apparent, the net result would be the provision of a better atmosphere than is supplied in many orthodox office structures. A properly designed plant with an adequate system of distribution would doubtless be erected. The question of lighting offers room for speculation. Some sunlight doubtless could be mirrored into the central shaft, but just how practicable would be the idea of distributing it to various rooms is hard to say. Even if artificial light had to be provided, the occupants would be no worse off than many whose lot it is to toil in the lower "court" rooms of a skyscraper. One uninviting feature would be the entire absence of "view"; but that might conduce to diligence and industry on the part of the workers.

The article estimates that the time required for completing the project will be "less than half of the time required in constructing a 50-story New York office building." Just where and how time would be saved is hard to imagine. Likewise, one wonders why the experiment—for such it seems to be—is not tried on a ten- or twenty-story building instead of as deep a one as is projected. That would have taken the "edge" off the account as newspaper material, but it would make it rather more credible.

John Hays Hammond Reminisces

He Concludes That the Engineer's Qualifications Fit Him for Public Service

WHEN I made my professional début there were but few educated engineers. Conspicuous among this number were Rossiter W. Raymond, the Janin brothers (Henry, Louis, Alexander, and Alexis), James D. Hague, A. J. Bowie, and Eugene de Crano. To Dr. Raymond, and I say this without invidious comparison, we owe more for the present high estate of the mining profession than to any engineer of his generation. If you seek his monument, look around, for the American Institute of Mining Engineers is worthy to commemorate the achievement of any successful engineer; it is the realization of the ambition, the unselfish and untiring efforts of Rossiter W. Raymond.

I came along close to the heels of these men — pioneers of the educated engineer. The title of mining engineer was not one to conjure with. Indeed, it required considerable temerity to confess that one was a college graduate. It was to the practical miner, so-called, that the capitalists of the day went for advice on mining matters, and they got it. The practical miner was supposed to have acquired his knowledge in the school of experience and to possess a monopoly of practical experience and "good horse sense." The capitalists of that day did not think it possible for an educated engineer to acquire practical experience nor to be level-headed. His education disqualified him in that respect. He was regarded as a theorist, but as we know of all wild theorists the so-called practical miner is *facile princeps.*

My own experience will illustrate the prejudice that then obtained against the educated engineer: After I returned from Freiberg, I had spent some months working underground and in the gold mills of California. This was to supply much-needed practical experience. The first job I got was from George Hearst, at that time the most important mining magnate of the country. He was the mining member of the wealthy and influential firm of Haggin & Tevis, who owned many of the famous mines, among which were the Anaconda, of Montana; the Ontario, of Utah; and the famous Homestake mine, of South Dakota.

Abstract from a speech delivered by Mr. Hammond on the occasion of the conferring on him of honorary membership in the A.I.M.E. at Boston, Mass., on Aug. 30, 1928.

Mr. Hearst had been an old-time friend of my father, and I felt sure that he would give me a position after I had told him about my studies at the Royal School of Mines in Freiberg. I was downcast by his statement that he had no job for me. Knowing that he had many positions in connection with his extensive mining operations, I told him that I would take any kind of job as a starter. Even that did not change his decision.

He said: "The fact of the matter is, Jack, you have been to Freiberg and have learned a lot of damn theories and big names for little rocks. That don't go in this country."

It was true I had some theories and certainly I had a lot of long German names for little rocks.

"Mr. Hearst," I said, "is that all you have against me—my German education?"

He said: "That is all." Then I said: "If you don't tell my father, I will make a confession to you: I haven't learned a blessed thing at Freiberg."

At that he gave me my first job, which consisted of reporting at an assay office at 7:30 each morning, crushing the samples of ore, making the fires, smelting the ore, and weighing out the button. This work would often take me until late at night, and all this for a compensation that would hardly provide the necessaries of life.

After six months of this work I went to Mr. Hearst again. I said: "Mr. Hearst, I have been making all of your assays, upon which you have based your estimates of the value of the mining properties you are examining. I have done everything myself in order to prevent any tampering with the samples, and I fear that I have been lost sight of in the shuffle."

He said: "No, you have stuck to the job longer than I thought you would. I have not forgotten you entirely, and I think you are qualified to do something better." Thereupon he offered me the position of superintendent of the Homestake mill, which at that time was the largest gold mill in the world. I accepted this position, but within a few hours by a coincidence I was offered a job with the U. S. Geological Survey, under Clarence King, the director, in connection with the examination of gold mines in California. This was in 1880.

Next day I told Mr. Hearst of this other offer, and he said, "Well, if I were you, I would take it. The government can better afford to pay for your experience. But," he added, "after you get your experience from the government, come back to me again." I never went back to Mr. Hearst, but I am confident that I could have saved him large sums of money and could have considerably increased his mining fortune.

I have heard more picturesque theories from the so-called practical miner when he posed as an expert in explanation of geological phenomena than could be found in the imaginings of the most fantastic romances. I recall a famous mining suit on the Comstock. It was a question of the accuracy of the surveys between the boundaries of two properties, in which was involved a rich orebody. The expert surveyor for one of the properties was getting away with his case, and he certainly had the jury favorably inclined toward his side on the question of the boundary. Just before leaving the stand on cross-examination, this fake surveyor was questioned by a bright lawyer on the other side. The question was, "How many degrees are there in a circle." Turning to the jury with a contemptuous smile, the fake surveyor said "Of course, *that* depends upon the size of the circle."

The lot of the mining engineer is not always a happy one. Certainly in the old days we traveled with far less comfort than is provided for the engineer of today. I recall a story told me by Prof. W. P. Blake, who, up to the time of his death, was a prominent member of the Institute.

Shortly after I had opened an office in New York, I was given by one of my clients a report made by Professor Blake, on a property on the Gulf of California. I read the report several times, and was mystified as to its purport. I told my client that I could not make head or tail of it; it seemed so long-winded and non-committal. A few days after this, Professor Blake called at my little office in the Mills Building. After exchanging the compliments of the season, he said, "You have done me, inadvertently, an injustice in your criticism of my report, but you are absolutely correct in saying that the report is long-winded and non-committal. Let me tell you the circumstances under which the report was made." He said: "I had been engaged by a Welsh

miner and his wife to examine a property they owned on an island, about 50 miles from Guaymas, Sonora. They had paid me part of my fee in advance. Just as I was about to set sail from Guaymas, on a little schooner, accompanied by the miner and his wife, an American friend whispered in my ear, 'Do you know who that woman is?'

"I said, 'No. I have no idea!'

" 'Well,' he said, 'she is the famous Bond Street murderess. She was tried for having murdered a dentist and disposed of the body in an acid bath, but, through some technicality, she escaped conviction. I advise you to be careful not to offend her.' "

Blake said it was too late for him then to chuck the job, so he went to the island and began his examinations. It was a copper property, and he soon found it had no value, the "ore" being chiefly copper stains. He tried to arrange to have his report made when he got back to New York, but his clients would not allow this, and insisted on the report being written on the spot So he had to write page after page, with beautiful illustrations, and use all the geological terms he could think of, to submit to his clients. They kept him there nearly three weeks, until he finally completed it. He said that he was afraid that, unless he inserted something favorable, an "accident" might happen to him during the night. He finally satisfied them, and they took the report, paid him the money, and came back to New York to sell the mine on the basis of that report. He asked me what else could he have done under the circumstances than to make the report long-winded and non-committal.

Engineering is a profession peculiarly broadening. The engineer is likely to be thrown into contact with every other sort of business and profession and into comradeship with every condition of man. He is necessarily in co-operation with the business man, the capitalist, the promoter, the manufacturer, the merchant, the industrialist, and the commercial man.

On the other hand, he is always close to the laborer at every turn. He must work with men of other professions: the lawyer, who must instruct him as to mining laws, the building laws, and construction; the architect, with whom he is in immediate collaboration; the doctor, who safeguards the health of the men and takes care of the sanitary conditions of the community; the newspaper man, who keeps the public informed as to the importance and success of his particular undertaking; the chemist, the statistician, the politician, the economist, and even in cases in which the engineer is more or less in charge of a large community—and this is not infrequent—the school teacher and the clergyman.

Engineering often takes a man into foreign lands, where he must know the laws of the country, and must understand its government, the customs of the people, the language, and international relations with other countries, the history of the country, and especially its geography and physical aspects. If he is given important work abroad he will come in contact with foreign business conditions and business methods, the economic situation, exchange, export and import trade, natural resources, railroad and shipping and thousands of other details which will give him a large international education combining the knowledge of many professions.

One opportunity which in the past has been largely confined to the profession of law will come in the future, I believe, to be more and more the engineer's. The engineer is exceptionally well qualified for public life. His professional training has been along scientific lines. He has developed ability to think straight and clearly—a trait singularly lacking in modern politics—as well as a sense of values and proper proportion, which enables him to determine the relative importance of factors not only in the solution of engineering but of other great problems.

He has been taught to seek the truth, irrespective of consequences, and to have the courage of his convictions. His reputation depends upon the realization of his predictions. Sophistry has no place in engineering. Engineers are not privileged to urge extenuating circumstances to explain their failures but are held strictly responsible. The lawyer may ascribe the loss of his case to an incompetent judge or corrupt jury. The doctor the loss of his patient to the will of God. The engineer cannot escape the odium of failure. He must make good. For these reasons engineers in public life will be able to exert a most beneficent influence and to counteract that of demagogues who are today beguiling the public with pleasing political panaceas.

There is justification for pride in the mining profession in that one of the great political parties has, in response to irresistible popular demand, nominated as its standard bearer a distinguished member of that profession. His training and experience, as an engineer, no less than his admirable character and transcendent ability, have enabled Herbert Hoover successfully to carry out the great enterprises which have made him one of the world's most notable benefactors.

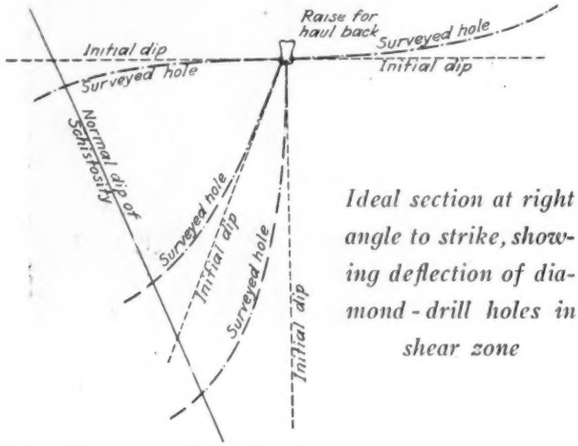
In his new field of opportunity, for we feel sure of his election to the Presidency, Herbert Hoover—engineer, philanthropist, statesman—will continue to render even more notable service to his country and to humanity.

Diamond-Drilling Practice at the Britannia Mines

By FRANK EBBUTT

Mine Geologist, Britannia Mining & Smelting Company, Ltd., Britannia Beach, B. C., Canada

THE Britannia ore deposits occur in a comparatively large roof pendant near the western boundary of the now famous Coast Range Batholith. This roof pendant is made up of rocks of the Britannia formation (Deveno Carboniferous), the series comprising dark slates with interbedded quartzites, and tuffs or basic flows. Within these are quartz porphyry sills (Britannia sills). This formation has undergone intense shearing, the mineralization occurring within this shear zone. The zone is slightly over 5 miles long and 500 ft. or more wide, with a fairly constant strike of S. 70 deg. E., magnetic, and a dip of 70 deg. to the southwest. Within the shear zone the rocks are altered to a fissile, chlorite quartz-sericite schist. Many phases of this rock occur; generally speaking, the best mineralization took place where the presence of the chlorite is most noticeable. Whether this chlorite is of pre-mineral origin or a result of mineralization has not been cleared up. The footwall of the shear zone is a fine gray slate, seldom more than a few feet thick, but persistent, both horizontally and vertically. There is often evidence of what appears to be thrusting on the footwall. A few small unsheared lamprophyre and diorite dikes cut the shear zone, but when observed do not penetrate the footwall slates.



Ideal section at right angle to strike, showing deflection of diamond-drill holes in shear zone

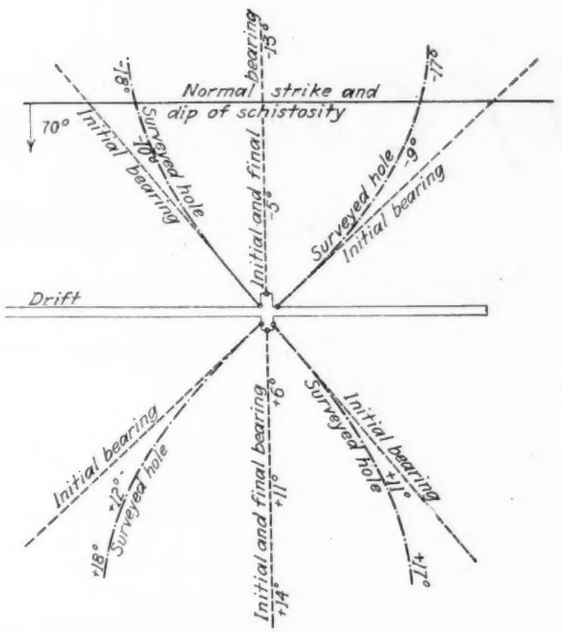
Mineralization consists of pyrite and chalcopyrite, with inferior amounts of sphalerite and minor quantities of gold and silver. Three of the orebodies have much in common; these consist of a number of almost parallel veins of widths up to 70 ft. A fourth orebody occurs in a highly siliceous zone. A fifth and less important one lies within the unsheared sediments, extending to the footwall of the highly siliceous one mentioned. Between the most westerly and most easterly known orebodies there is a distance of roughly 17,000 ft. These known orebodies are apparently arranged almost radially from some unknown common source, those on the flanks being deeper-seated than the two more central ones. Those wishing to go into the geology further, should refer to the authorities below.[1]

Development of these orebodies now comprises some 65 miles of drifts, crosscuts, and raises. The 1927 production amounted to 34,000,000 lb. of copper and total production since 1906 has amounted to well over 300,000,000 lb.

Diamond drilling has been carried on intermittently over a long period, roughly 80,000 ft. (16 miles) having been drilled since 1918. Prior to 1925 all diamond drilling was done on contract, various types of machines being used. Early in 1925 the company (Britannia Mining & Smelting Company, Ltd.)—a subsidiary of the Howe Sound Company—purchased a Longyear U.G. type air-driven machine, with a drilling capacity of 750 ft. and giving a core $\frac{15}{16}$ in. in diameter. A competent foreman of world-wide experience was employed and a good selection of carbons procured. Since the purchase of this machine it has been in constant operation—two shifts a day. No bits have been lost. Standard "E" type core barrels and rods, and "ES" bits are used. The number of stones set varies from 6 to 25, according to the type of ground being drilled—the more stones set, the smaller they are. This setting of small carbons entails a lot of work for the setter, but results in a marked saving. From two to four bits are used per shift and from 10 to 30 ft. is drilled per shift. The average ground drilled has a hardness of about 5.5, often reaching 7 in the siliceous cherty areas typical of the westerly ore deposit. From time to time carefully selected carbons are added to cover depletion.

All core is filed in specially constructed trays, each of which holds eight rows of core 5 ft. long. These trays are filled lengthwise, like drawers, in racks 7 ft. high, built in series. In this way a big footage of core is stored in a comparatively small space, with all core equally accessible. The end of each tray or drawer is marked with the number of the hole and the footage represented by the contained core. Holes are numbered in this way: 2—22—5, 2 being the particular mine or orebody, 22 the level, and 5 the number of the hole on that level. All mineralized sections are split, one half being assayed and the other half replaced in the tray. All

[1]Geological Survey of Canada No. 996, 1906, LeRoy; Geological Survey of Canada Sum. Rept., Pt. B., 1918, Schofield; Geological Survey of Canada Sum. Rept., 1913, McConnell; *Economic Geology*, May, 1926, Schofield.



Ideal plan, showing deflection of horizontal diamond-drill holes in shear zone

sludge is caught and samples are taken for every 10 ft., these being assayed and recorded, as well as the core assays.

Careful costs are kept, and monthly cost sheets are submitted to those interested, including the diamond-drill foreman, setter, superintendent, and the geologists. The total cost per foot for 1927 was $2.96; the direct cost, $2.56. Of the drilling done in 1927, 87.7 per cent was in the hard, siliceous section of the mine. (See typical cost sheet.)

Britannia Mining & Smelting Company
Diamond-Drilling Costs

	1927	
Operating Expense	Very Siliceous Ground Average per Foot	Less Siliceous Ground Average per Foot
Runners' labor	$0.364	$0.268
Helpers' labor	0.257	0.203
Superintendence (Setting)	0.345	0.344
Carbon loss	1.271	0.554
Drill supplies	0.070	0.073
Shop labor	0.051	0.036
Shop supplies	0.022	0.028
Moving equipment	0.083	0.157
Total direct cost (comparable to usual contract basis)	$2.463	$1.663
Indirect Expense		
Rental (second machine)	$0.063	
Station cutting	0.345	$0.034
Power	0.046	0.036
Lubricants	0.009	0.015
Geology (includes splitting core)	0.051	0.024
Core boxes	0.012	
	$0.526	$0.109
Total cost	$2.989	$1.772

The drill runner at the close of each shift makes out a "Diamond Drill Runner's Daily Report," giving the following information:

Hole number; mine; date; shift; name and number of runner and helper; depth from and to which drilled; footage drilled; core recovered; formation; and remarks. This is signed by the foreman.

A member of the geological department examines the core daily and splits all mineralized portions for assaying; he also makes out a complete log in triplicate.

All holes longer than 100 ft. are surveyed by a member of the geological department. The Mass Patent Compass and gelatine are used in a glass thermos tube, inserted in a bronze retainer. This is attached to two standard bronze drill rods, to avoid attraction of the needle by the string of regular steel rods. A small gasoline "Primus Stove" is used for heating the jelly underground. This is convenient, as it is easy to carry, makes no smoke, and heats water quickly. The length of time required to lower the rods into the hole governs the strength of the gelatine used. It should always be as weak as possible. The temperature of the water in the drill hole must also be taken into consideration, for naturally as this temperature rises, stronger jelly must be used.

Some interesting conclusions have been drawn from the observations made on a large number of surveys. It is safe to say that holes drilled in the shear zone will be deflected as follows:

1. All holes drilled toward the footwall and horizontal will curve downward.
2. All holes drilled toward the hanging-wall and horizontal will curve upward.
3. All holes drilled obliquely toward the footwall will swing toward the footwall and down.
4. All holes drilled obliquely toward the hanging-wall will swing toward the hanging-wall and up.

In other words, holes tend to become normal to the dip and strike (that is, at right angles to the dip and strike). See the ideal plan and section. Advantage is taken of these conclusions in planning the bearing of new holes, and as much as 25 deg. is sometimes added to the initial bearing or dip required to reach the objective. These observations will not hold when drilling in unsheared or massive ground, as other factors, like faults and slips, then influence deflection.

A thorough appreciation of the drift or deflection of diamond-drill holes is absolutely essential when estimates of ore reserves are based or partly based on data obtained by diamond drilling. If the actual angle at which the hole cuts a vein or orebody is different from that assumed, grave mistakes may be made in tonnage estimates. I do not want it felt that these observations in any way reflect on the usefulness of diamond drilling either here or elsewhere, as I am a strong advocate for drilling as an aid in exploration, blocking-out of orebodies, and structure finding.

Additional references to the literature on Britannia will be found on page 459.

Specimen diamond-drilling record sheet

Form No. 92

Britannia Mining AND Smelting Co., Limited

DIAMOND DRILLING RECORD — FICTITIOUS — Sheet No. 1

By F. E. — Date March 1, 1928

Hole No. S - 18 - 18 Mine Bluff — Level 1800

Location Footwall Drift West

Bearing North 45° West — Dip Horizontal — Length 450 Feet

Latitude of Collar 3,660.5 — Departure of Collar 38963.0 — Elevation 1108 feet

Date	Footage	Sample No.	Assay Values Cu.	Ag.	Au.	Zn.	Fe	Geology and Remarks
3/1/28								
	0 - 50						48'	Barren chlorite schist (buttons)
	50 - 74						13'	Lamprophyre a/ka.usahe rod
	74 - 188						60'	Barren chlorite schist (buttons)
	188 - 190						8'	Firm silicified schist
	190 - 198	66500	1.9	.03	Tr	nil	6'	Mineralized, siliceous
	198 - 206	66501	1.0	.10	.02	nil	7'	" "
	206 - 214	66502	1.8	.07	.03	nil	7'	" "
	214 - 283						51'	Barren chlorite schist, fir.
	283 - 361						66'	Partially ore red quartz porphyry
	361 - 450						69'	Foot-wall rock, with gypsum
							450	

This hole was surveyed, results to fall as:

At 100'	bearing N 43° E.	Dip	-4°
" 200'	" N 40° E.	"	-9°
" 300	" N 34° E.	"	-15°
" 400	" N 26° E.	"	-21°

Re-treatment of Comstock

Indicating the Scope Cyaniding or Furnacing for of Gold, Silver and

THE original ores of the Comstock Lode consisted chiefly of quartz and calcite. In places a considerable amount of pyrite appears, with minor amounts of galena, chalcopyrite, and sphalerite. The chief silver minerals are argentite, stephanite, and polybasite. Most of the gold is free. A composite analysis of the ore, obtained by averaging the results from the early workings of several mines, is shown in Table I.

The history of the milling of Comstock ores from the 'sixties to date would call for a review of the development of precious-metal metallurgy. However, a brief outline of the methods employed will give a better basis for studying the difficulties that are to be expected in the final re-treatment of the remaining residues.

Amalgamation was accepted as the main recovery method in the earliest days. The large tonnage of good-grade ore from the Comstock Lode attracted the best metallurgical talent of the time, and developed there the highest skill in the art of amalgamation, including the auxiliary chemical preparation of the ores and mechanical operation. In this work 0.5 to 6.0 lb. mercury was used per ton of ore. The mercury loss probably averaged about 2.5 lb. per ton of ore treated.

The better grade of tailings from the ores milled were impounded, often near the works. In many instances the same tailing was reworked several times before it entered the main outflow waste stream that had its course down Seven Mile Canyon to the Carson River. Following the water course down the canyon the tailing was re-impounded; and, as metallurgy advanced, new plants were erected to again re-treat it. The most successful of these plants used forms of amalgamation, chlorination, and cyanide methods. To the tailing from the re-treatment plants, smaller tonnages of untreated tailing produced by milling lower-grade ore are continually added.

Table I—Composite Analysis of Comstock Lode Ore

	Per Cent.
Silica (SiO_2)	87.73
Alumina (Al_2O_3)	1.19
Magnesia (MgO)	2.10
Lime (CaO)	1.13
Manganese (MnO)	0.65
Soda (Na_2O)	0.36
Potash (K_2O)	0.80
Iron (Fe)	1.00
Zinc (Zn)	0.64
Copper (Cu)	0.24
Lead (Pb)	0.34
Sulphur (S)	1.50
Water (H_2O)	1.46
	99.14
	Ounces per Ton
Silver	145.00
Gold	2.92

Along the stream bed down the canyon a series of blanket runways were constructed, and each was independently operated for several years. All or the heavier portion of the stream flow was run over the blankets; in this way much of the heavier concentrate, mostly sulphides and mercury products, was reclaimed.

The residues finally entered the run-off flow with the sewage from Virginia City and waste from the gas works, sawmills, and stables. As the accumulation along the bed of the Carson River became a nuisance, the lighter and better grade of tailing was impounded on the banks of the river. This accounts for the large dumps locally known as "Douglas tailing."

Douglas Tailing Contains Recoverable Mercury

The analysis of Douglas tailing resulting from the various treatment methods used on the original Comstock ores differs from the analysis of the original ore. Almost all the free gold and a high percentage of the silver minerals have been removed by former milling methods. Much of the heavier sulphide material has been removed as concentrate. The remaining sulphides, which are mostly from the slime portion, are partly oxidized by weathering.

Re-treatment is most important for the recovery of mercury lost in the amalgamation process and of copper introduced as sulphate to assist amalgamation. Part of the mercury remaining in the tailing has united with base metals, part has formed sulphides, and the remainder is mostly oxidized. Most of the copper introduced as sulphate was precipitated by the iron parts of the treatment equipment. This metallic copper is now partly amalgamated and sulphidized. The metal content of the Douglas tailing approximates 2.8 oz. silver, 0.055 oz. gold, 0.5 lb. mercury, and 0.12 per cent copper.

Gravity concentration of Douglas tailing gave a low recovery of the precious metals. Cyanidation gave good extraction of the gold and silver, but the cyanide loss from soluble copper was excessive. A preliminary acid wash followed by aëration-oxidation insured good cyanidation results. However, the precious-metal recoverable would not pay for the added cost of the preliminary treatment with acid.

Flotation Treatment with Kraut and Callow Cells

The Dayton Syndicate Company remodeled an old cyanide plant into its present flotation works. At this plant the tailing is delivered by horse scraper to a log washer. The pulp is elevated to supply tanks that provide a constant head to the flotation system. Kraut

Tailings

for Flotation, the Recovery Mercury

By E. S. LEAVER* and J. A. WOOLF†

HISTORY has shown that the technical inefficiency and inadequacy that so frequently marks the exploitation of a high-grade ore provides an available reserve of low-grade material for the next generation, to be drawn upon as scientific research is stimulated by economic necessity. As a result, the development of a technique in the retreatment of tailing from gold and silver mills operated in bygone times is of considerable importance; but, curiously enough, little or no attention has been paid to the recovery of the quicksilver in such tailing, considerable amounts of which have been lost during the calcining of zinc precipitate. This article is of value, not only for the information it contains about the recovery of quicksilver, but also because it discusses the scope for flotation and cyanidation in the treatment of such material.

cells are used as roughers and Callow cells for retreatment. Finished concentrate is taken off the first set of Kraut cells, and the product from the re-treatment cells is returned to the head of the first Kraut cell. The concentrate is collected in small rectangular ponds. The ponds are arranged to fill alternately, allowing a period for partial air drying. Laboratory flotation tests are recorded in Table II. The best recovery closely approximates that of plant practice.

For the recovery of mercury, the wet concentrate from the ponds is fed by hand into a reverberatory furnace to about 800 deg. C. Fume and dust from the furnace are drawn through scrubbing towers to the fan and forced through the condensing system. A considerable flow of water is used in the scrubbing towers; this flow, carrying the bulk of the dust, is settled in ponds. The mud thus collected, together with the product from the base of the condensing tubes, is retorted for the recovery of mercury. The original Douglas tailing assays nearly 0.5 lb. mercury per ton, and the concentrate about 27 lb. per ton. Recovery of mercury is about 50 per cent.

The residues from the reverberatory furnace and the retorts are shipped to the smelter for recovery of the silver, gold, and copper present. One lot of the shipping product assayed 140 oz. silver, 2.5 oz. gold, and 3 per cent copper, giving an indicated recovery of about 50 per cent.

Preliminary water wash did not aid flotation of the Douglas tailing. This is shown in Tests 1 and 2. Acid pulp as shown in Test 3 gave the lowest flotation recovery. Alkaline pulp as shown in Test 4 depressed the pyrite and made for lower results. Aërofloat added during pulping, cresylic acid added at the head of flotation cells, and sodium sulphide added at intervals in the flotation cells gave maximum recovery. This method of adding the reagents closely follows present plant practice.

Direct cyanidation of Douglas tailing has been a commercial failure, chiefly because of excessive cyanide loss caused by cyanide-soluble copper. A series of cyanide tests is shown in Table III. The object of these six-cycle tests is to bring out the proposed method for the regeneration of cyanide used to extract the copper. The cyanide solutions were reused on two to four separate batches of ore in order to accumulate copper, gold, and silver in the solutions before precipitation and to save the cost of multiple precipitation.

Sodium sulphide was used as the precipitant. It was added to the clear pregnant solution in amounts slightly less than that required to precipitate all the metals. The solution was then made slightly acid with sulphuric acid. This precipitated almost all the silver and copper, but only about 10 per cent of the gold. After removing the precipitated metals, the solution was made alkaline with lime (CaO), which reacts with hydrogen cyanide to form calcium cyanide. The solution was then treated with zinc dust to precipitate the gold. Precipitation

Table II—Results of Flotation Tests on Douglas Tailing

(Heading assayed 2.83 oz. Ag., 0.055 oz. Au., 0.5 lb. Hg per ton)

Test No.	Reagents Used: Xanthate	G.N.S. No. 22	G.N.S. No. 17	Pine Oil	H_2SO_4	Soda Ash	Cresylic Acid	Aërofloat No. 15	Na_2S	Ratio of Concentration	Assay, Ounces per Ton: Concentrate Au	Concentrate Ag	Tailings Au	Tailings Ag	Recovery, per Cent: Au	Ag
1	0.2	...	...	0.2	...	...	...	...	...	11.8 : 1	0.270	12.0	0.035	1.98	41.7	36.0
2	...	1.0	0.25	0.1	...	...	...	...	...	17.5 : 1	0.385	15.8	0.035	2.02	40.0	31.8
3	...	1.0	0.25	0.1	5.0	...	...	...	...	23.9 : 1	0.286	12.6	0.045	2.40	21.8	18.7
4	0.2	...	...	0.2	...	5.0	...	...	5.0	21.7 : 1	0.300	16.3	0.043	2.08	25.1	26.5
5	...	...	...	...	...	...	0.1	0.2	5.0	14.3 : 1	0.320	15.7	0.035	1.86	40.7	38.8

Sodium sulphide was used as the precipitant. It was added to the clear pregnant solution in amounts slightly less than that required to precipitate all the metals. The solution was then made slightly acid with sulphuric acid. This precipitated almost all the silver and copper, but only about 10 per cent of the gold. After removing the precipitated metals, the solution was made alkaline with lime (CaO), which reacts with hydrogen cyanide to form calcium cyanide. The solution was then treated with zinc dust to precipitate the gold. Precipitation

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†Junior metallurgist, U. S. Bureau of Mines.

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Table III—Results of Cyanide Tests on Douglas Tailing, Showing Regeneration of Cyanide by Sodium Sulphide-Sulphuric Acid Precipitation Method

(*Heads assayed* 2.78 *oz. Ag.*, 0.055 *oz. Au.*, 0.5 *lb. Hg per ton, and* 0.122 *per cent Cu.*)

Cycle No.	Period of Treatment, Hours	Cyanide Loss, Pounds NaCN per Ton of Ore: Before Regeneration	Cyanide Loss, Pounds NaCN per Ton of Ore: After Regeneration	Cyanide Regeneration, Per Cent	Tailing Assay: Oz. per Ton: Au	Tailing Assay: Oz. per Ton: Ag	Tailing Assay: Copper, Per Cent	Extraction, per Cent: Au	Extraction, per Cent: Ag	Extraction, per Cent: Cu
1	24	3.0	....	....	0.0075	0.35	0.070	86.4	87.4	42.6
2	24	3.2	....	....	0.0080	0.36	0.066	85.5	87.0	45.8
3	24	3.5	....	....	0.0080	0.36	0.060	85.5	87.0	50.8
4	24	3.2	0.73	77.3	0.0090	0.40	0.066	83.7	85.7	45.8
5	24	3.5	....	....	0.0090	0.35	0.061	83.7	87.4	50.0
6	24	4.0	0.80	78.7	0.0090	0.40	0.058	83.7	85.7	52.5

and regeneration must be done in gas-tight tanks, to prevent the escape of hydrocyanic acid.

Each cycle of the tests shown in Table III consists of a 24-hour all-slime treatment at 45 deg. C. The strength of solution was approximately 2 lb. NaCN, and the dilution ratio was 5:1. The filtered solution from each cycle was used for the treatment of the new charge of tailing in the next cycle. Cyanide was added to keep the cyanide strength about constant. The solution was not subjected to precipitation treatment until after the fourth cycle, and then again after the sixth cycle.

Regeneration of Cyanide Practicable

Consumption of sodium sulphide was proportional to the amount of metals to be precipitated. In these tests the total sulphide consumption amounted to 0.83 lb. per pound of copper precipitated. The amount of acid consumed equaled the protective alkali present in the solution plus the cyanide, including that liberated by acid. Computed in terms of copper precipitated, the acid consumption in these tests was 9 lb. H_2SO_4 per pound of copper. Solutions higher in copper content showed as low as 4 lb. acid per pound of copper precipitated.

The average cyanide loss before regeneration was 3.4 lb. NaCN per ton of ore and after regeneration, 0.753 lb., which is equivalent to a regeneration of 78.0 per cent. Average copper extraction was 47.9 per cent, which is equivalent to dissolving 1.17 lb. copper from each ton of tailings. The generally accepted reaction for the dissolution of copper carbonate by cyanide requires seven molecules of cyanide for two atoms of copper; one of the cyanide molecules forms NaCNO. On this basis, 1.17 lb. copper would require 3.13 lb. NaCN for dissolution. Assuming then that 3.13 lb. NaCN per ton of ore was used by the soluble copper, and that it was from this loss that the regeneration was effected, the percentage regenerated becomes 48.7 per cent, which is only 1 per cent less than the theoretical maximum.

The sulphide-acid treatment precipitated all the copper and silver, but only about 10 per cent of the gold. Zinc dust was used to precipitate the remainder of the gold.

If zinc dust be used to precipitate copper, silver, and gold from cyanide solutions where the copper content accounts for excessive cyanide loss during the leaching period, the cyanide solution upon reuse will soon become fouled with zinc. As the percentage of zinc in the cyanide solution increases, the reuse of the solution results in corresponding decrease in the extraction of the metals, particularly of silver. Decreased extraction was noticeable when the solution contained about 0.15 per cent zinc. When it contained 0.36 per cent zinc, the cyanide extraction of silver dropped from 90 per cent to 75 per cent. This action explains why zinc precipitation cannot be satisfactorily used in cyanide practice when there is much soluble copper in the ore.

The old Douglas tailings now being handled by flotation are pumped back and reimpounded after treatment. These still contain enough gold to warrant consideration of re-treatment methods.

A three-cycle series of tests was made on the flotation plant tailings, using sodium sulphide-sulphuric acid precipitation. The procedure was the same as that used with the original tailings, except that the solution was treated with sodium sulphide and sulphuric acid after the third cycle, and the gold was then precipitated with zinc dust. Results are shown in Table IV.

Discussion of Results of Floation Plant Tailings

The average cyanide loss before regeneration was 2.42 lb. NaCN per ton of ore. After regeneration the cyanide loss was 0.92 lb. NaCN per ton of ore, showing a regeneration of the total cyanide used of 62.6 per cent. The copper extracted per ton of ore was 0.642 lb., which, according to the accepted reaction would require 1.72 lb. NaCN. The cyanide regenerated amounted to 1.53 lb. NaCN per ton of ore. Since almost all the cyanide regenerated would come from that used by the copper, the regeneration figured on this basis would be 89.2 per cent. The small amount of cyanide used to dissolve the silver and some of the mercury would also be regenerated, which may account for the fact that the regeneration figure just given is a little above the theoretical maximum.

The cyanide loss, 0.70 lb. per ton, which is not due to soluble copper, is higher for the flotation tailing than for our sample of original Douglas tailing. This seems to be because the sample was taken from a different part of the dump and contained more organic matter.

Table IV—Results of Cyanide Tests on Flotation-Plant Tailing, Showing Regeneration of Cyanide by Sodium Sulphide-Sulphuric Acid Precipitation Method

(*Heads assayed* 1.45 *oz. Ag.*, 0.025 *oz. Au.*)

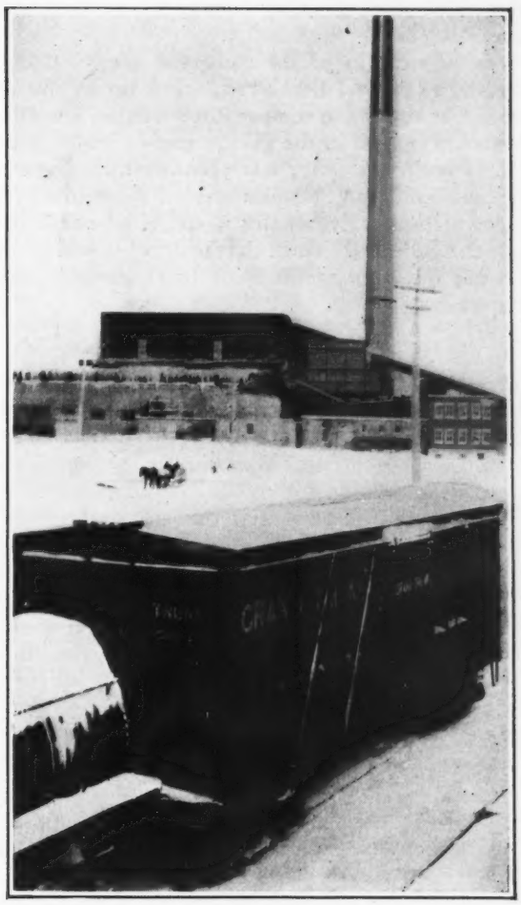
Cycle No.	Period of Treatment, Hours	Cyanide Loss, Pounds NaCN per Ton of Ore: Before Regeneration	Cyanide Loss, Pounds NaCN per Ton of Ore: After Regeneration	Cyanide Regeneration, Per Cent	Tailing Assay, Oz. per Ton: Cu	Tailing Assay, Oz. per Ton: Ag	Extraction, Per Cent: Au	Extraction, Per Cent: Ag
1	24	2.55	....	....	0.004	0.20	84.0	86.0
2	24	2.40	....	....	0.003	0.17	88.0	88.0
3	24	2.31	0.92	62.6	0.005	0.25	80.0	82.5

The Noranda Enterprise

Difficulties of Smelter Operation— Their Solution

Concluding Installment

By A. H. HUBBELL
Associate Editor



The Horne smelter, last February

IN THE previous installment, in the issue of Sept. 15, the smelter log for the blowing-in period was presented. A more detailed account of the difficulties encountered at that time and subsequently is given in this issue. Each of the component units of the plant is considered separately

The Primary Crushing Plant

Three bins are provided at the primary crushing plant. Two of them, of 125 tons' capacity each, are intended to hold custom ore. In the meantime, one is filled with waste which is being crushed to supply road material for the newly laid out streets of the Noranda townsite, and the other with converter slag skulls. The third, or mine run bin, is of 350 tons' capacity. It is flat-bottomed, with two discharge openings in the bottom, so that about 120 tons can be drawn out by gravity.

It was found that in the severest weather (below —20 deg. F.) the ore could not be stored above ground for any length of time without freezing, although on the average it shows only 3 per cent of moisture. Frozen ore would hang up in the cars when they were inverted by the dumper. Several hundred feet of snow shed was therefore built to house the track between the shaft and crusher bin. Moreover, at the outset the mine cars could enter the bin from one end only, and time was lost in switching and dumping. Alterations were made so that the motor train could run on to the bin from the opposite direction as well. The rotary dumper takes seven three-ton cars at once.

Crushing equipment consists of two 36x24-in. jaw crushers, each set to 3 in. and driven by a 75-hp. induction motor. Four pan feeders are provided, two to each crusher, so arranged that the ore may be fed to the machine from either side. Originally there was a grizzly chute between each feeder and its crusher. These, however, were broken by the heavy ore in the first week of operation, so the spaces between the bars were filled with timber and the entire tonnage was sent through the jaw crushers. It was found also that the feeders ran too fast, and speed reducers were installed. A difficulty not yet overcome is the lack of pick-up magnets before the crushers, as a result of which tramp iron and steel must be taken out by hand. The magnets were omitted because of the magnetic nature of the ore.

Two 24-in. belt conveyor lines run from the primary to the secondary crushing plant, from the latter to the sampler, and thence to the roasters, thus permitting the two classes of ore to be kept entirely separate. Much difficulty was experienced during the cold weather by reason of the fact that the tail pulleys of the two conveyors between the crushing plants were 6 to 8 ft. underground in the primary crushing building, and the pit in which they were mounted served as a catch basin for the water from the adjacent hill. Pumping was impracti-

cable. The pit would quickly fill with ice, save immediately around the moving belt and pulley. Much labor was expended in continually chopping and shoveling the ice away.

Proper lubrication of the conveyor idlers in the conveyor galleries proved difficult to secure during the coldest weather. At times the temperature was so low that the grease would not go in the grease gun or in the pressure fittings. Finally the latter were removed, the grease was cleaned out, and thin Atlantic red oil substituted. This gave satisfaction. Eventually a steam line will be run through the galleries. Until that is done, it will be necessary to use different methods of lubrication in summer than in winter.

The Secondary Crushing Plant

In the secondary crushing plant on each unit the product of the coarse crushers is passed over vibrating screens, the oversize going to two fine-reduction gyratories driven by 50-hp. motors; thence, after similar screening, to two 16x54-in. rolls, belt-driven from 100-hp. motors. Originally it had been planned that the jaw crushers would reduce to 3½ in., the gyratories to 1 in., and the rolls to ¼ in. However, the primary crushers are now set to 2 in., the gyratories to ⅞ in. by means of over-size mantles, and the rolls to $\frac{3}{16}$ in. in the effort to get a final ¼-in. product for the roasters. Nevertheless, considerable over-size goes to the latter because the rolls deliver their product directly, without screening, to the conveyors. The Horne ore does not decrepitate on roasting, and over-size remains over-size throughout, in consequence. Originally, ¼-in. mesh screen, set at 33 deg., was used on the vibrating screens. This was changed to ⅜-in. screen set at 30 deg., and it is now intended to use ½-in. mesh to decrease the tonnage going to the rolls.

Among the slight changes that it was found desirable to make in the secondary plant equipment were, first, to shift the vibrating screens that feed the gyratories forward by 9 in. The reason for this was that the conveyors from the primary plant at first discharged directly on to the wire surface of the screen, cutting it out rapidly. By moving each screen forward the stated distance, the impact of the falling stream was received at the head of the screen, above the screening area, where an ore cushion at once built up. Moreover, it was found that the workmen who had installed the gyratories had turned the spiders at right angles to the direction of the feed instead of in line with it, thus reducing the capacity of the machine. This error was corrected.

Difficulty has been experienced with the rolls through the frequent breakage of the lugs on the bottom of the cast-iron bearing pedestal. This is supposedly caused by over-size when the rolls are pulled up close. The pedestals are to be cast in steel to remedy the trouble.

Ore Is Hard

The Horne ore is hard, being rated at 1 plus as compared with 0.37 to 0.70 for Arizona ores. The method used for determining the scale of hardness, here referred to, is essentially that outlined in *Trans.* A.I.M.E., Vol. LXI (1919), page 237. The higher the coefficient of grinding resistance, the harder is the ore. A. J. Weinig, of the Colorado State Testing Plant, at Golden, gives the scale in Table I, which is based on tests made at the plant.

Table I. Scale of Hardness, according to A. J. Weinig

Portland ore (standard)	1.00
Climax Molybdenum Company	.92
Miami Copper	.70
Evangeline (American Metal Company, Pecos)	.67
Katydid (Pecos)	.64
Homestake (unaltered ore)	.63
Morenci (Phelps Dodge)	.53
Utah Copper	.38
Ray Consolidated	.37

So hard an ore wears down the roll shells rapidly and unevenly. Corrugations in the shell are turned down by mounting a cutting tool on the roll frame, reversing the direction of rotation, and running the roll at slow speed. A complete cut ordinarily takes one or two days, sometimes longer. Carborundum blocks, two to a roll, held against the shell as it revolves at normal speed, are also used. These are said to aid by lengthening the period before tool grinding becomes necessary. Blocks such as these were formerly used at the Lake Shore mill, in Kirkland Lake, but the practice there has been discontinued on the ground that it tends to make the surface of the shell too smooth to nip well. However, at the Horne it is said that a new shell with abrasive blocks will run ten to fourteen days before cutting becomes necessary. No opportunity exists under the present practice for shifting the rolls from coarse to fine crushing at 24-hour intervals, as is done by Calumet & Arizona at Douglas, to lessen the corrugations.

The Sampling Mill

The product of the rolls is elevated by conveyors through a gallery to the sampling plant. This section of the conveyors is long and is driven from its midpoint. The sampling mill can be operated as two separate units, so that two different materials can be sampled at a time. It is equipped with two sets of 18x10-in. rolls, four sample grinders, and four 48-in., two 36-in., and two 28-in. Vezin samplers. Two bucket elevators are provided for returning the reject to the conveyor belts. Each of the four Vezin samplers cuts a tenth. After the second cut, the sample is crushed in the rolls, cut again, passed through the grinder, then cut a fourth time. At this stage it represents one ten-thousandth part of the original lot. It is now split in a riffle, passed through a 100-mesh screen, ground if necessary, and sent to the laboratory. All rejects go to the conveyor belts and thence to the roasters.

Dust a Nuisance

Some nuisance from dust is experienced in the conveyor galleries. Where two different materials, one high-grade, such as slag skulls, and the other low-grade, such as siliceous fluxing ore, are being conveyed at once on the parallel belts, cross-salting through dusting is not impossible. Besides this, the dust is unpleasant for the workman. To avoid inhaling it he wears, or is supposed to wear, a respirator nose bag made of light cotton flannel, which is soaked when clean in a mixture of glycerine, soda ash, and water. This is made up in the proportion of 300 grams of soda ash, 180 c.c. of glycerine, and 2 liters of water, a formula that was borrowed from the International smelter, in Arizona. To alleviate the dust nuisance, water sprays in both divisions of the crushing plant have been proposed, it being desired to avoid the expense of a vacuum dust-collecting system.

Twenty to forty minutes is lost in the crushing and sampling departments every time the ore is changed. During this interval the entire system is cleaned throughout as far as the conveyors that run from the sampler to the roasters. This loss is inevitable and is usual in plants operated on a custom basis.

The reader, patient or impatient, has now arrived at the roasters. The ore while passing to the bins is

weighed on a continuous weighing machine known as a weightometer. Eighteen bins, each of 325 tons' capacity, are provided for storage of the basic sulphide ore. For the siliceous fluxing ore there are eight 140-ton bins. Ten silica bypass bins of 20 tons' capacity (each) for bypassing silica to the converters are situated in between the latter. There are ten calcine hoppers, each holding about 15 tons.

Delivery of ore to the bins from the belt coming from the sampling mill is effected by means of a distributor or shuttle conveyor. From the bins the ore is fed to the top hearth of the roasters by pan conveyors.

Roasting Vs. Smelting Capacity

The desire of the designers, as said before, was to provide a plant capable of smelting 1,000 tons of ore per 24 hours. They therefore prescribed two reverberatories, each nominally of 500 tons' capacity, but actually capable of smelting 700 to 800 tons daily (and more, as is being done at present). For the two reverberatories, eight Wedge roasters were provided, each capable of roasting 150 tons of feed per 24 hours, or 1,200 tons, equivalent to 1,080 tons of calcine, for the eight combined. However, inasmuch as the first reverberatory is already smelting over 900 tons per day, it follows that six of the eight roasters are required to supply the calcine called for. Obviously, before the second reverberatory can be placed in commission, additional roasting capacity must be provided, or else both reverberatories must be run at about half of their actual capacity. This, however, cannot be done and give the low smelting cost and low fuel ratio (10.7 per cent), now obtained. Furthermore, it may be possible—indeed, Mr. Boggs expects to do it—to put 1,000 tons daily through the one reverberatory, thus attaining with it the capacity sought for the entire plant originally. In this event all eight roasters would be required.

If further roasting capacity be desired, it can be provided either by adding additional roasters or by remodeling the present ones. The latter have one drying hearth and seven roasting hearths. They also have cast-iron arms, which are larger and heavier than reinforced steel arms of equal strength would be and require more space between the hearths than the steel arms would necessitate. It can be seen, therefore, that by using roasters having air-cooled reinforced-steel arms, which discharge the hot air onto the cooler hearths, with a third less space between the hearths and a larger number of hearths, considerably greater capacity could be obtained, with the same floor area and headroom, and more efficient roasting. With air-cooled arms discharging on to the hearths, the air needed for roasting could be introduced through the arms, instead of by leaving the doors open as is necessary with the present type of apparatus. Further, the roaster would be air-tight and its temperature and the roast under complete control, when the air is pre-heated. The additional hearths would give the ore a greater number of drops. Finally, four arms instead of two could be provided, which would serve to stir the ore to a greater degree, in thinner layers. In short, much benefit could be derived by a study of Colonel Stout's roasters at the Copper Queen smelter, which were superimposed on top of the reverberatories in 1926.[1]

It might also be added that steel arms are more easily removed than cast-iron arms. One of the former can be changed, when necessary, in 1½ hours.

Left, the converter aisle. Right, the car dumper at the primary crushing plant

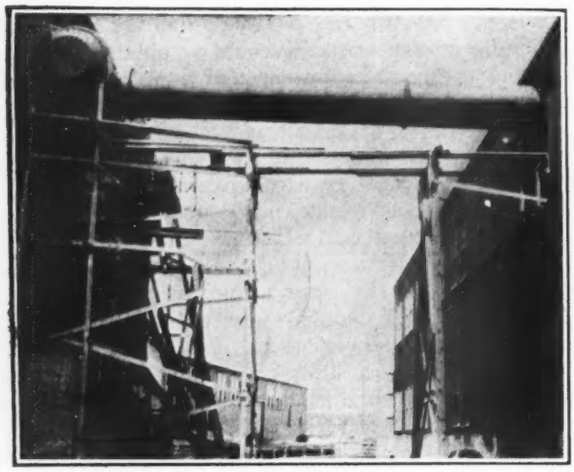
Rather more time than is desirable is required to start one of the roasters, when cold, owing to the type of powdered-coal burner used. This is of special design and not easily replaced. After heating 24 hours with powdered coal, the ore is fed. Calcining begins after 24 hours more, and by the time a third 24-hour period has elapsed, the furnace is roasting properly.

The roasters set back of the reverberatories. The calcines discharge directly into the ten calcine hoppers and then into five-ton cars pulled by storage-battery locomotives. Some delays are experienced in switching, owing to the fact that six roasters are used on one reverberatory, the track having been laid out with the idea that four would be sufficient. Likewise, some heat (probably several hundred degrees) is lost in the transfer, thereby increasing the fuel ratio.

The Reverberatories

The reverberatories are quite modern in their dimensions, being 25x100 ft. inside the brickwork. The excellent results that have been obtained with the one now in commission have quite upset the original calculations. Originally, the recuperator provided was expected to take the entire volume of gas from the one reverberatory. However, it has been found necessary to use the bypass also. With the low draft the two are just sufficient to

[1] "Copper Queen Smelter"; J. Moore Samuel.



The air line to the converters has been elevated, as shown

take care of the gases from the 90 tons of coal now burned every 24 hours. Their combined capacity could be increased only by increasing the draft. This, however, would decrease the tonnage smelted and increase the fuel ratio.

Fusing in the Bottom

The furnace was built on a sloping site with the skimming end uphill. Before any brick were laid, the ground was made level by tamping in clay, which was then dried with salamanders. On this hard, tamped, dried surface the brick side walls were erected. When the brickwork was completed, the bottom was raised to the level of the tap hole by filling in with 3½ ft. of fine silica sand that had first been dried on steel plates. No slag or other proper filling material was available in the vicinity. The sand was purchased at a near-by point. All except the top 4 in. of this filling consisted of sand running 98 per cent in silica. For the 4-in. layer this high-silica sand was mixed with another sand equally fine and containing small quantities of iron and alumina.

In fusing in the bottom and beginning smelting no trouble was experienced with either the bottom, the side walls, or the arch. As stated in the log, wood fires were started at the firing end at 3:20 p.m. on Nov. 21, 1927, and gradually increased until Nov. 27, when movement of the arch ceased. They were kept unchanged until 8 a.m., Dec. 1, when the two center powdered-coal burners were turned on at the rate of 30 lb. of coal per minute. In the afternoon these were shut off and the two on the outside started. The burners were alternated every six to eight hours in this fashion until 10 a.m. of Dec. 12, when all four were put on. On the afternoon of the same day the bottom began to fuse at the firing end and the coal was increased on all burners. Further increases were made at 4 and 10 a.m. on Dec. 13. By early afternoon the bottom near the skimming door was fusing. By 7 p.m. the four burners were taking 100 lb. of coal per minute. At this time fifteen tons of calcines and ten tons of siliceous ore were charged. Three hours later the bricks in the arch were dripping; about 75 tons of calcines were charged and the fire was decreased. By 4 a.m, Dec. 14, the charge was fairly smelted, so the burners were shut off and the furnace was sealed up until 2:30 that afternoon, when all four burners were put back on and the fire was gradually raised. When the furnace was hot again, regular charges of calcine were put in and smelting begun slowly. The first skim was made at 2:50 a.m. the following day (Dec. 15) and at 4 a.m. the first matte was tapped. It ran 23 per cent copper and the slag 0.26 per cent.

The Bridge Wall Goes

A week after the first matte had been tapped trouble developed with the bridge wall. (This wall proved to be quite unnecessary.) With the fire on one side and the hot charge on the other it was found to be going fast, and matte was leaking into the secondary air duct. This was remedied, as shown in the log, by bricking up the ends, including the air duct, filling the latter with liquid converter slag to within two feet of the burners, filling in above this with silica sand, and then letting the bridge wall go as it might. This was accomplished with little loss of smelting time. The net result today is that the capacity of the furnace has been increased through the rebuilding of the end.

Changes in the Recuperator

At the outset a temperature of 1,000 deg. F. was obtained from the recuperator for the secondary air. The hot gases are passed through eighteen 20-in. diameter Hybnickel tubes into the flue. Flowing at right angles is the current of cold air which runs via brick baffles around the tubes and, taking up their heat, flows through a firebrick silocel-lined duct to the reverberatory as the secondary air.

It was found that coal ash speedily choked the tubes by reason of the baffles in them. These were taken out, as well as the arch below the tubes, to permit the removal of the ash. An effort will be made to remodel the recuperator so that it will produce air of a higher temperature. Leaks in the system have reduced the temperature of the air to a point varying from 275 deg. to 400 deg. F., it being lowest at night when the recuperator ash accumulates, and have also necessitated the installation of two fans in addition to the size 7 Sturtevant multivane (25-hp. motor) previously used to get the air into the furnace.

Waste-Heat Boiler to Be Installed

As for the second reverberatory, the brickwork is completed. Slag topped with silica sand will be used for filling the bottom. Further work on it is held up, however, pending the installation of a 750-hp. (nominally) waste-heat boiler, which is to serve the following purposes: (1) To heat the new concentrator; (2) to heat all buildings of the smelter to permit proper lubrication; and (3) to cool the gases below the melting point of lead on account of the lead flashings in the stack. The second furnace, in consequence of the waste-heat boiler, will have no recuperator and therefore will use cold secondary air. It naturally will not smelt the same tonnage as the other.

Slag is run to the dump in 225-cu.ft. dump cars pulled by twenty-ton storage-battery locomotives.

The Converters

Two 12x26-ft. Peirce-Smith converters blow the matte to blister. As there is no holding furnace, it is easier to blow small charges. Save when blowing to copper, therefore, a charge is always kept in both converters, one going up as the other comes down—this to keep the blowing engine from wasting air.

Hoods of the sulphuric acid type are used on the converters, although movable hoods are to be preferred. The

converter aisle is served by two 40-ton electric cranes.

The converter slag launder used for returning the converter slag to the reverberatory was formerly placed at the side, but is now put through the firing wall.

Monitors have been installed in the roof of the converter building to improve the gas conditions.

The Converter Air

Air is supplied at 14 lb. (maximum 20 lb.) by a 21,500-cu.ft. blowing engine, a duplicate of which serves as a standby. Recently two steel pipes, set in cement, have been used as intake duct for one engine. These are understood to be satisfactory.

When the plant was erected the airline from the power house to the converters was buried in the ground. It has since been excavated, in part replaced with new pipe, and elevated overhead as shown in one of the illustrations. It may now be inspected easily. To make the change necessitated that the air be cut from the converters for 43 hours.

Besides these blowing engines, the power house contains two 2,500-cu.ft. 100-lb. air compressors for the mine; two small 400-cu.ft. 100-lb. air compressors, one for mine and one for smelter; also two motor-generator sets, each having a 575-hp. induction motor and a 60-kw. 125-volt generator for exciter and plant control service; a 430-kw. 250-volt generator for crane, and storage-battery service.

For casting the blister, two straight-line casting machines are provided. Originally these were driven by an alternating-current motor, the speed of which was adjusted so as to cast two molds per minute. This proved too slow, so a variable-speed direct-current motor with gear reduction was substituted for the alternating-current drive, making it possible to cast four molds per minute.

The Coal-Pulverizing and Precipitation Plants

What is considered a satisfactory ratio of fuel to solid charge—namely 10.7 per cent, wet coal—is being obtained despite some handicaps. The fuel charged to smelting includes the wet coal as bought, plus any shortage on delivery, plus the coal used for drying, and, finally, the coal lost in the drier.

The coal-pulverizing plant includes eleven concrete-stave bins, each 24 ft. in diameter, providing in all storage for 4,200 tons. On receipt, the coal is dumped into a track hopper, whence it is fed to a breaker underneath, which crushes it to 1 in. A conveyor then delivers it either to storage in the bins or directly to the pulverizing plant. Here it is dropped through a vertical plate drier. Midway on its downward course over the sloping plates the coal is brought directly in contact with a stream of hot gases moving at right angles to its path. These gases, which effect the drying, originate in an ordinary coal-burning firebox situated to one side, from which box they are pulled across the path of the falling coal by a suction fan. Some trouble was experienced at this stage during the past winter. The gases, 350 deg. F. in temperature and carrying water vapor from the coal burned to produce them, on coming in contact with the falling coal, which often had a temperature of 20 deg. or more below zero, promptly condensed their moisture on the coal, so that the latter emerged still wet from the drier. From the drier the coal, still wet, is screwed to two 36-in. pulverizers, each of six tons' hourly capacity. At this point air separation is made use of, the air, in closed circuit, blowing the coal, when sufficiently fine, into a cyclone settling tank. From this it is screwed out into another current of air which blows it over the furnaces. From 91 to 92 tons of coal is being burned per 24 hours with one furnace in commission. Considerable coal is lost in drying by being blown out with the hot gases.

The Cottrell Plant

Converter and roaster gases, but not the reverberatory gases, are sent to the Cottrell electric precipitation plant. The dust is rapped down every six hours. In May, 332 tons of dust was recovered from the roasters, or 1½ per cent of the ore fed. This dust is higher in copper and silver and lower in gold than the original feed. An extra track has been run from under the Cottrell plant onto the reverberatory feed floor so that the Cottrell dust can be run to the furnace in the winter without going outside.

The 422½-ft. reinforced concrete stack has already been described, in the *E.M.&J.* of April 21, 1928.

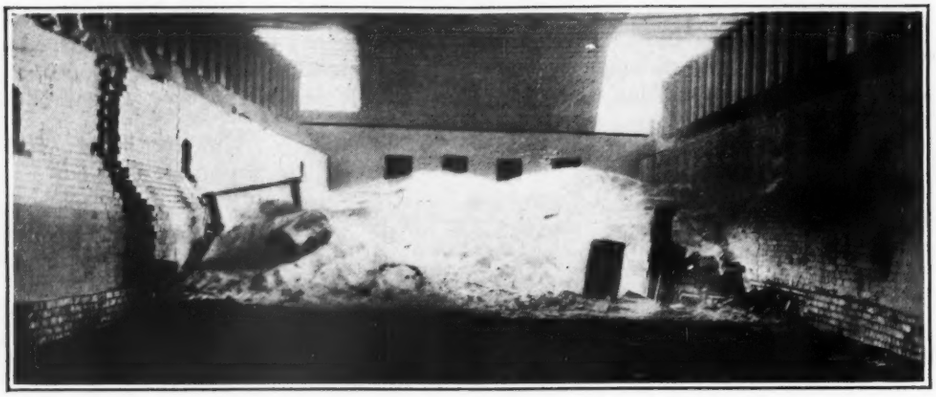
Instrumental Control

Dependence on instruments for furnace control rather than entirely on the eye of the practical man is advocated by Mr. Boggs. The Horne furnace is run entirely with instruments. A draft gage in the main arch shows the condition of the draft, which must be kept between 0.025 and 0.04. The CO_2, plus SO_2, moreover, must be kept between 17 and 17.5. This is difficult, because it is necessary to let false air into the uptakes to cool the waste gases going to the bypass and the recuperator and then to the balloon flue, in order not to burn out the lead flashings of the stack. For this reason the gas sample cannot be taken in the uptake, but must be taken through the main arch of the furnace. No CO is allowed and only 0.1 to 0.2 per cent O_2. Orsat tests are being made early every morning and late every afternoon. If anything is wrong, tests are made throughout the day. Incidentally, the superintendent is looking for a satisfactory CO_2 recorder to work under these severe conditions.

Four recording pyrometers are used—one on gases going up the bypass; one on those entering the recuperator; one on the inlet for the cooling air for the recuperator; and one on the cooling air when it leaves the recuperator. An indicating thermometer is placed on the secondary air entering the coal burners. Other instruments used are: a recording pyrometer on the gases entering the breeching of the stack; two draft gages on the respective entrances for the roaster gases and the converter gases to the Cottrell plant. A platform is provided 135 ft. up on the stack to permit sampling of gases going up the stack, so as to make it possible to figure stack losses of copper, gold and silver.

The air receiver outside the Horne power plant

Mr. Boggs says he knows of no other copper-smelting plant using hot secondary air on its coal burners. Recently, Mr. J.



No. 2 reverberatory, not yet completed, after pouring 18 in. of slag in bottom

Howard, the general foreman of the smelter, has succeeded in shortening appreciably the powdered-coal flame. This has resulted in materially reducing the fuel ratio and increasing the tonnage.

Plant Organization

Before concluding, a word about the smelter organization is appropriate. The plant is divided into five divisions, each of which is in charge of a man having specialized experience in the work under him. The divisions are:

1. Preparation, including unloading, crushing, conveying, sampling, weighing, and delivering to the roaster bins.

2. Roasting and Cottrell plant.

3. Reverberatories. (The reverberatory men draw the dust from the Cottrell plant and deliver it to the reverberatories.)

4. Converters. This includes everything in the crane aisle. Matte is delivered to the crane aisle by a transfer car and then handled by the converter men. An exception is that skulls are delivered into a car in the converter aisle and taken to the ore bins by the preparation department.

5. Mechanical department. This department is divided into two large subdivisions—mechanical and electrical. Each head of these subdivisions reports directly to the smelter superintendent. The Cottrell plant, consisting almost entirely of electrical apparatus, is controlled by the chief electrician. The four other departments report directly to the general foreman of the smelter. This simplifies the organization and allows one man to co-ordinate properly the crushing, roasting, smelting, and converting.

Each of these departments has a sharply delimited field of activity. Under such conditions it is easy to determine responsibility and to make proper charges.

A concentrator is now in course of construction. The smelter will crush the ore intended for it to $\frac{1}{4}$-in. size and receive concentrates in return.

No story of starting and operating the Noranda smelter would be complete without giving credit where credit is due. The ingenuity, hard work, and co-operation of the whole staff, which was chosen by Mr. Kenneth Williams, has been most unusual, says Mr. Boggs. It would be difficult to pick out one without mentioning all, but it might be advisable to mention Mr. J. Howard, general foreman of the smelter; Mr. Ed. Anderson, in charge of the reverberatories, and Mr. H. Nicholson, in charge of the roasters.

Tungsten Resources of the Union of Soviet Socialist Republics

THE U.S.S.R. has announced that the tungsten ore deposits of the Transbaikal region of Siberia are open to exploitation by foreign firms. The deposits are about 100 miles southeast of Chita, between latitudes 50 and 52 deg. and longitude 86 and 88 deg. (from Leningrad). About fifteen beds have been prospected and a few of them exploited, but the resources are practically untouched.

In the period extending from 1915 to 1918 about 170 tons of concentrate was produced and for several years thereafter production ceased entirely. The Soviet Rare Elements Trust has been in charge of production, but lack of capital has hindered its activities. In the past two years about 450,000 rubles was invested by the trust in the tungsten industry, of which about 65,000 rubles went for prospecting work. It is estimated that to prospect the deposits would require from 1,000,000 to 1,500,000 rubles. The Precious Metals trust is exploiting one of the beds in this district for aquamarines and topazes.

The output of tungsten ore by the Rare Elements Trust falls short of satisfying the demand in the Soviet Union. For 1928 the requirements of ferro-tungsten amount to 800 tons and this figure will be increased to 1,000 tons next year. This means that from 1,300 to 1,600 tons of 65 per cent wolframite concentrate is needed, but the domestic output is not expected to reach 200 tons. The small scale of operations makes it impossible to introduce up-to-date methods and results in high production costs. The average analysis of the Transbaikal tungsten ore shows 75 per cent wolframite, 15 per cent FeO, and 9 per cent MnO.

The undeveloped condition of the Soviet deposits has compelled the importation in the past few years of ferro-tungsten to the value of more than a million rubles per annum. Soviet authoritieis consider it desirable to have the Transbaikal tungsten deposits exploited by a foreign firm under a concession agreement. The domestic market would have priority rights of purchase, the surplus production going for export.

Development of Flotation at Broken Hill

By E. J. HORWOOD
Superintendent of Mines, Broken Hill Proprietary Company, Ltd., Broken Hill, New South Wales

WHEN the Broken Hill ores became of lower grade, it was necessary to take steps either to remove some of the siliceous gangue by concentrating, or to treat the ore by some process other than smelting, which had until then been simply performed in blast furnaces. Both these alternatives were adopted. A concentrating plant was built, in which the coarser part of the lead carbonate ore was treated in jigs and the finer part on large, slowly revolving, conical tables. This process was fairly successful for the lead, but not so satisfactory for the lighter and flaky silver minerals. When the ore was too low-grade for this concentration process to be effective, a chloridizing and leaching process was used. The silver occurred both as native silver and as silver iodide, and had to be roasted with salt in revolving furnaces, which were 30 ft. long and 4 ft. in diameter. The product was then dumped into vats 16 ft. in diameter and 8 ft. deep, and leached with hyposulphite of soda solution, the silver being subsequently precipitated with sodium sulphide, which was, in turn, sent to the smelter. Amalgamation was also practiced for a time, for the recovery of the silver.

Exhaustion of the oxidized ores brought a new problem. Some of the mines actually treated the sulphide ores as a waste product. They could not be smelted directly, as the presence of zinc would soon clog up the furnaces, to say nothing of losing the zinc. As they were a fine-grained mixture of lead and zinc sulphides, it was at first considered impossible to separate the minerals by mechanical means.

Gradually it was demonstrated at Broken Hill that by fine grinding and subsequent treatment on jigs and oscillating shaking tables a lead concentrate could be secured with a recovery of 70 to 75 per cent of the lead and 45 to 50 per cent of the silver. This concentrate was smelted at Port Pirie, after roasting, to eliminate the sulphur, in long, flat Ropp furnaces, with large rakes mechanically drawn through the furnaces for rabbling the ore. The product was then briquetted. An improved method, that using the H. & H. pots, followed, this in turn being improved by Messrs. Carmichael and Bradford, who mixed gypsum with the concentrates before roasting in the pots. A still later development was the Dwight-Lloyd process.

Zinc was still a problem, the specific gravity of the zinc mineral being about the same as that of the gangue. It therefore went with the tailing, and as much as 10,000,000 tons of zinc-bearing residues accumulated in huge dumps at Broken Hill. Some success was obtained with dry magnetic concentration, but the dust caused considerable lead poisoning. Efforts to develop a wet magnetic machine were unavailing.

It was in 1902 that the recovery of zinc from the ore by flotation was hit upon. The former general manager, Mr. Delprat, directed our then research officer, Mr. Carmichael, to try boiling the tailing with salt cake—acid sulphate of soda—of which a considerable tonnage was left over from the leaching process. The idea was the possibility of dissolving the zinc. Carmichael made the experiment, but, rather discouraged, took the glass beaker down to the general manager's office, remarking that he could not get the stuff to settle. On showing the beaker to Mr. Delprat, the latter recognized the marked distinction between the black scum on the surface and the balance of the tailing, and exclaimed: "Why, this is the very thing we are after; the zinc is floating!"

Patents were applied for at once, but later on it was found that another investigator, Potter, had already hit upon the idea of flotation. His patents, however, were so involved with other operations that his process was impracticable. Litigation followed, but in the end the Broken Hill Proprietary paid the Potter company a substantial sum as settlement.

IN CARMICHAEL'S beaker, the acid in the salt cake acted on the small amount of carbonate in the ore, producing carbonic acid gas bubbles. Owing to the aversion of sulphide crystals to being wetted, the gas as generated attached itself to the zinc in increasing quantities until there was sufficient to buoy the zinc particle to the surface. This action went on in the boiling solution until no zinc remained unfloated.

The next problem was to apply the principle on a commercial scale, and this involved much experiment and development work. Various kinds of sloping copper pans with gas jets below to maintain the temperature were first tried, but were found too slow and too costly in operation.

Pointed boxes were used, about 6 ft. deep and 4 ft. square on top, the feed being gradually poured into the top on one side, while hot, acidified solution, 200 deg. F., was squirted out of a pipe near the bottom of the box. By having a blind pocket, called an appendix, and two pipes, it was found possible to feed the material in at the top and have a continuous discharge of worthless material at the front hole. The zinc meanwhile floated on the surface as a thick black scum and overflowed into a launder. The appendix served another purpose, as foreign objects such as stray bolts or stones were caught in it instead of blocking the outlet pipe.

Abstract of a paper presented by Mr. Horwood before the Broken Hill staff at a recent meeting in New South Wales. His comments on the development of mining methods at this interesting property were published in these columns in the issue of August 25.

From 10,000 to 12,000 tons weekly of zinky tailing was treated by the initial flotation plant. Grinding to 40 mesh was necessary to make the zinc float. Four million tons of tailing yielded a million tons of concentrate. The finest slime, however, was not amenable to this treatment, nor to concentration by tables or vanners. Several hundred thousand tons of this material was therefore treated by heap roasting, being subsequently smelted for the lead content. The sulphurous gas from the roast yard was not appreciated by the residents of Broken Hill. The Minerals Separation Company found means to float the slime, but the resultant product, being a mixture of lead and zinc, was suitable neither for the zinc nor the lead smelter, and for some six years after the discovery of flotation no means of separating the zinc from the lead in slimy sulphides was found.

IT WAS noticed that lead in the slime dump became oxidized by exposure to air more rapidly than zinc, and knowing that such oxidized lead was incapable of floating it occurred to me that this oxidation might be achieved rapidly by artificial means. After a low-temperature roast, the zinc could be floated as a high-grade zinc concentrate, the lead not being affected. The flotation process used required oil, under patents controlled by the Zinc Corporation, which had erected a large roasting furnace and operated the process for a year prior to the outbreak of the World War. After that broke out, there was no market for slime zinc concentrate, so the plant was closed down.

As it was necessary to pulverize and dry the slime before roasting, investigation was conducted looking toward the development of a wet process. Lister, the mill superintendent of the Zinc Corporation, first achieved this object by taking advantage of the natural tendency of the lead sulphide to float more readily than zinc sulphide. Soon afterward Bradford, ably assisted by Henderson, discovered means of enhancing the flotability of the lead sulphide. This formed the basis of the Bradford process, which was carried on by the company until the recent closing down. Bradford observed that sulphide particles all seemed to have films of air or oxygen around them, which, unless the lead sulphide was particularly bright, tended to enhance the floatability of the zinc, making it about equal in this respect to the lead sulphide, with the result that both sulphides floated simultaneously.

Bradford reasoned that, if he could remove all the air from all the sulphides, the natural property of the lead to float more readily than zinc would assert itself. He found that by bringing the soluble gas, sulphur dioxide, in contact with the ore, it would, by diffusion, dilute the air so as practically to displace it with the soluble gas, and, as this latter would be instantly dissolved, the particles of zinc and lead would be thus freed of air and gas, and on being subjected to the flotation process only the lead would float, by reason of its natural tendency to do this preferentially to the zinc sulphide.

BRADFORD also discovered that addition of a small percentage of copper sulphate to the ore greatly enhanced the floatability of the zinc sulphide by depositing a film of copper of infinitesimal thickness on the particles of sulphide, thus brightening their surfaces. By using this mineral after the lead was floated, the zinc floated more readily than it otherwise would. Though Bradford patented his main sulphur dioxide process abroad, he did not attach sufficient importance at the time to the use of copper sulphate to induce him to patent the use of copper sulphate in countries beyond Australia. Had he done so, he would be earning an income in royalty, from the United States alone, probably as great as any man in Australia, for in that country millions of tons of ore per year have been treated largely by its use. In view of the readiness by which lead and zinc sulphides could be separated by the Bradford process and, as the degree to which fine grinding was carried prior to the reopening of the mine in 1923 did not unlock all the lead and zinc, finer grinding was decided on to make the ore suitable for treatment in the slime flotation plant by Bradford's process, and thus increase the recoveries of metals.

Hitherto the object had been to grind the ore with the production of a minimum amount of sliming, but the reverse was now the aim.

The crude ore is crushed in gyratories to about 2 in., then in rolls to pass a screen with $\frac{3}{32}$-in. holes. Recovery of coarse lead by jig treatment after the roll crushing was still thought advisable. The jig tailing is then ground in tube mills, using flint pebbles, in closed circuit with drag classifiers. The overflow of the classifiers is thickened to 60 per cent solids in Dorr thickeners.

Experiments with a small unit demonstrated that the sulphides could, contrary to the general belief, be floated without the use of oil (for which another company held patents), provided the pulp is sufficiently agitated in the presence of carbonic acid gas and air—the former liberated by the action of sulphuric acid on the carbonate present.

THIS agitation is carried out by passing the pulp through a machine like a centrifugal pump, capable of thoroughly emulsifying the air. Many have noticed at times of heavy pressure in the water mains that when the tap was turned slightly on the water had a milky appearance. This is the result of air being emulsified with the water when squirted out of the tap in a fine stream. This is the condition of the solution in the treatment vessel. The bubbles, being extremely small, readily grow on the surfaces of the sulphide particles and buoy them to the surface, owing to their aversion to being wetted.

A flotation plant on a working scale was erected as a result of the experiments for the purpose of producing a mixed lead and zinc concentrate. In the lead section of the plant, the pulp is first subjected to agitation with acid, oil, and tar, sulphur dioxide gas also being admitted to the suction end of the centrifugal agitating pumps. Some of the reagents are also added during the passage of the pulp through the nine sections forming the lead section. The lead concentrate from the first six sections is a final concentrate; that from the last three is returned to the head of apparatus. A temperature of about 90 deg. F. and a pulp density of 30 to 35 per cent solids gives the best results.

The zinky tailing from the lead section, after being thickened, is stored in vats, where the pulp is kept in motion to prevent settling. Its temperature is raised to about 130 deg. The pulp is then elevated to the head of the zinc section, where more acid and a little copper sulphate are added. Five agitators and cells are used in this section, the concentrate from the last unit going back to the head of the machine. The concentrate is, however, cleaned in another three-compartment machine, using clean water, where the zinc content of the final concentrate is brought up to about 45 to 50 per cent. Lead concentrate is pumped to tanks for settling, the thickened concentrate then being pumped to filter presses, where

the moisture is reduced to 9 per cent. Zinc concentrate is pumped a quarter of a mile to settling areas, where, four or five months after the dammed area has been filled, the concentrate is sufficiently dry to ship.

When first erected, in 1916, this plant was used mainly for treating the large dumps of accumulated slime, and, altogether, up to the end of 1922, about 800,000 tons was treated, together with current slime. Since that date the plant has been used for the joint treatment of the crude ore from the Broken Hill Proprietary and Block 14, and, for about a year, slime from the Sulphide Corporation.

ONE of the problems being undertaken by our staff is the recovery of lead from the residues resulting from the treatment of slime dumps. Owing to exposure to the air, a portion of the lead is oxidized and cannot be floated with the sulphide portion. As we have dumps of these residues, containing about 500,000 tons, with a material percentage of lead with silver, the question of a suitable method of treatment is an important one. Already several methods of treatment have been worked out, but a decision in regard to the best of these has not yet been reached.

Promising Outlook for Domestic Quicksilver Industry

WITH prices at a high level, the quicksilver industry is entering an era of prosperity. Production is increasing, though it is yet considerably below the pre-war level, according to H. W. Gould, reviewing quicksilver in "Mineral Industry" (McGraw-Hill Book Company).

Domestic production in 1927 was higher than in 1926 by nearly 50 per cent, and a further increase in 1928 would not be surprising. Of the recent installations, virtually all furnace plants are of the rotary type. A growing tendency to include dust precipitators of the Cottrell or cyclone type with the rotary furnaces is an outstanding feature of recent metallurgical practice in the reduction of quicksilver ores. Another variation in present practice is suggested by the use of thin alloy sheet metal for condensers at a property in Brewster County, Tex. This innovation suggests improvement in an important phase of operations. Present practice is to use tile condensers, which are unsatisfactory because of their low heat conductivity. Ordinary iron condensers are out of the question, however, because of the rapidity with which they are attacked by acid mercury fumes.

Cleaning and Lubricating Wire Rope

THE most effective way of cleaning a wire rope, preparatory to lubricating it, is by means of a suitable wire brush, according to the engineering department of a prominent wire-rope manufacturing company. This method has been found effective in the manufacturer's laboratory in cleaning discarded hoisting ropes which had been returned from time to time, for study.

Lubrication of wire ropes is usually accomplished with the aid of a split funnel or a trough, in which the lubricant may be poured while the rope is slowly passing through it. Under these conditions, the engineering department states, it is usually necessary to employ a suitable wiper, possibly in the form of a piece of sheepskin, to wipe off the excess lubricant which may cling to the rope. It is also desirable to apply the lubricant hot, to secure maximum penetration. The ideal wire rope lubricant is one which, when applied hot, will penetrate to the hemp center of the rope, as well as the inside wires, of the individual strands. If this is accomplished, preservation of the center will be assured, and internal friction within the rope itself will be reduced to a minimum. Various wire-rope lubricants which congeal and practically seal the rope on the outside are not desirable, and usually result in the rope being corroded on the inside and in places where the lubricant does not penetrate.

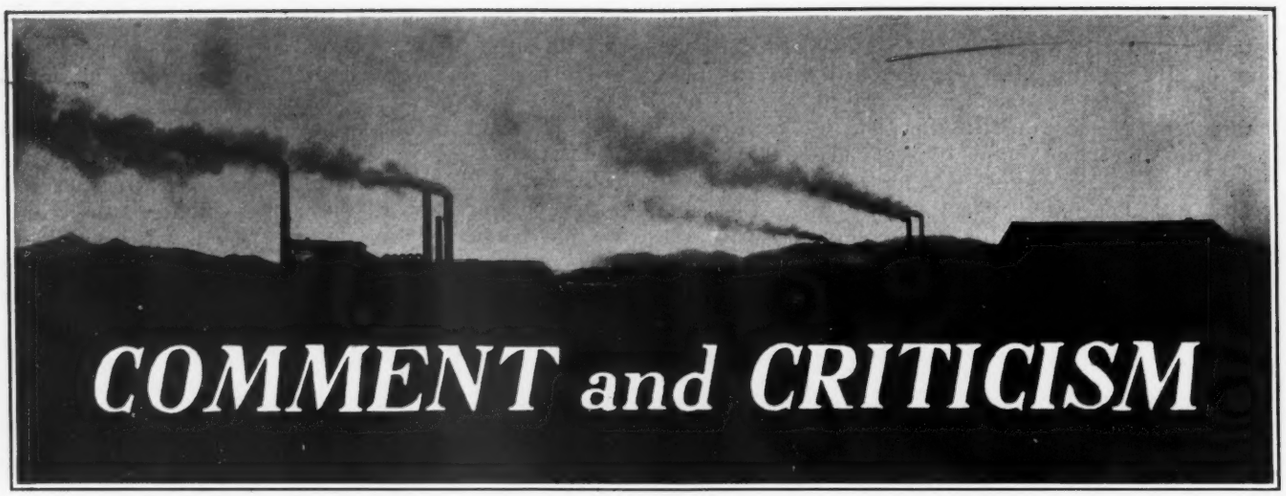
Literature on Britannia Mining

(Continued from page 447)

Any one interested in the history, geology, and mining methods at Britannia should look up the following references, as well as those already cited: "General Mining and Milling Practice at Britannia Mine, Howe Sound, B.C.," C. P. Browning, *Trans.* C.I.M.M., 1922; "Operations at Britannia Mines," J. I. Moore, Jr., *Engineering and Mining Journal,* Dec. 11, 1926; "The Britannia Copper Mine, B.C.," E. A. Haggen, *Mining Magazine,* Sept.-Oct., 1923; "The Concentration of Britannia Ores," H. A. Pearse, *Trans.* C.I.M.M., 1927; "Electrical Prospecting at the Britannia Mine," J. I. Moore, Jr., and Frank Ebbutt, *Trans.* C.I.M.M., 1926; and "Flotation Progress at Britannia," A. C. Munro and H. A. Pearse, *Mining Congress Journal,* July, 1926.

Opportunities in the Clay Industry

MODERN metallurgical equipment and practices are penetrating into the china clay industry, as seen in the discarding of hand-discharged settling troughs and their replacement with efficient classifiers, in addition to the use of modern thickening and filtering equipment. An example of this change will be pictured in a forthcoming issue, illustrative of what is taking place in the china clay industry of North Carolina. The vast china clay beds in Cornwall will also be shown; and an article by Mr. G. J. Young discusses the clay industry of the Pacific Coast, with particular reference to opportunities in the mining and technology of clay and the marketing of the final products. Mining and metallurgical engineers soon find their feet in a "fringe" industry such as this.



COMMENT and CRITICISM

Lack of Modern Transportation and Ore-Dressing Facilities Hampers Development of Indian Refractories

THE EDITOR:

Sir—As the result of an examination during the last year of deposits of aluminous refractories in northern India, Dr. J. A. Dunn, of the Geological Survey of India, has been able to give some idea as to the resources available in the country. In Assam, the deposits of sillimanite and corundum occur in the neighborhood of Sona Pahar, in Nongstoin State. To a depth of only 10 ft. for the majority of the deposits, Dr. Dunn has estimated at least a total of 83,000 tons available, including float ore. "Probable" or "possible" reserves may be many times this amount. In judging economic value, the location of these deposits is a grave disadvantage, and under transport conditions the freight would be high.

The deposit of corundum sillimanite in Rewa State, central India, is near Pipra. The total quantity available has been estimated by Dr. Dunn to be at least 100,000 tons. Of sillimanite, the estimated quantity is 1,000,000 tons, of poor quality, with perhaps 100,000 tons of good material. The possibility of exploiting the better-class sillimanite, however, is limited, owing to its intimate admixture with impure material. There is, besides, the additional disadvantage of a very high freight cost to Calcutta. At present the ore is carried by bullock to Mirzapur, a distance of 120 miles. Transport costs would be considerably reduced by constructing a bullock cart track to the bank of the Son River, whence the material could be floated down the Son and Ganges rivers on barges.

The deposits in the Bhandara district in the central provinces were also fully examined, but the amount of ore, according to Dr. Dunn, cannot exceed more than 100 tons each of corundum and sillimanite. Also in the Barabhum tract, in Bihar and Orissa, it is doubtful if 100 tons of good material could be collected easily.

In the Singhbhum district in Bihar and Orissa a series of deposits of kyanite rock extends over 70 miles. The largest deposit is that at Lapsa Burn, at the western end of the belt. Here the débris alone would, according to Dr. Dunn's estimate, provide at least 234,000 tons of kyanite rock. This, however, is a conservative estimate, the actual available quantity being possibly ten times this amount. Another good deposit is at Ghagidih, about three miles south of Jamshedpur, where about 20,000 tons is available.

At Rakha several hundred tons of massive kyanite may be recovered from the alluvium shed. In the remainder of the belt, to the southeast of Rakha, little or no massive kyanite-rock is associated with the kyanite-quartz granulite, but the latter may find a market in the future. S. G. WARTY.

Bombay, India.

How Quickly Would the Boulder Dam Be Filled With Silt?

THE EDITOR:

Sir—I have read Mr. Creighton O. Waldorf's interesting and suggestive letter on the subsidence of the Colorado River delta, in *Engineering and Mining Journal* of June 23. Without questioning the statement that the Colorado River delta has in the past subsided several times, I would point out that some of the evidence advanced by Mr. Waldorf does not necessarily prove that it has. He says, "A characteristic section of the delta material of the Colorado from the surface down shows fine silt, coarse silt, silt and sand, coarse sand, fine gravel, coarse gravel with small boulders. . . Then it repeats itself, the finest silt being found directly below the coarsest gravel." He takes this order of stratification as evidence showing that the delta is subject to periodical subsidence. This is not the only interpretation that may be put on this order of stratification, for it is one that naturally follows in building up the valley of any large river with sediment. Such an order of stratification found below sea level could, I believe, be taken as evidence of subsidence, for it could not occur under any great depth of still water, as in the Gulf of California, or even in comparatively shallow water.

The valleys of rivers are not built up by a succession of layers of sediment deposited directly by a succession of floods, as is often supposed. The material in a river advances downstream by being deposited and eroded again innumerable times. This depositing and eroding proceeds upstream in a sort of a wave. That is, the sand and gravel depositing on the upstream side while it is being worn away on the downstream side gives the appearance of a wave of something advancing upstream. These waves may be found at intervals of a few inches up to several miles. This alternate depositing and wearing away sorts the material into layers of different sizes. At the foot of the slope of erosion, which is also the beginning of the slope of deposit, the coarse gravel is deposited; a little further down, a little finer gravel is deposited; further on, a still finer material, and so on. As the wearing away advances upstream, this order of deposition advances also, each grade being deposited on top of material one degree coarser than itself. The water at the foot of the erosion slope proceeds outward and fan-wise, and slightly up or at a little flatter grade than the general grade. As it proceeds it drops in sequence the different sizes of gravel, the coarsest first, and so on; and the very finest last, at the top of the depositing slope. This

gives the order of deposition of which Mr. Waldorf speaks. Such a mode of erosion—depositing, eroding, redepositing—is universal. It occurs in creeks, rivers, tailing dams, launders and on hillsides and mountain-sides.

How about the repetition of this order, with the finest silt immediately below the coarsest gravel? If the river runs in any particular part of its bed higher than elsewhere, it may then, after a big flood, start another channel, which it proceeds to build up, as it did the other, to such a height that it again switches to another channel. Or, it may switch back to the old one, which is now lower than the rest of the valley, where before it was higher. When it does so, the low place is built up with fine silt until it is up to grade. Then the depositing and wearing-away process begins, with its consequent sorting of material, with the coarse stuff, as always, on the bottom and above the fine silt.

The most interesting parts of Mr. Waldorf's letter are the figures he gives on the amount of detrital deposited on the delta of the Colorado. He says some authorities maintain that it amounts to a cubic mile in eight years. One cannot help but wonder what effect this will have on Boulder Dam. How long will it take to fill with silt, sand, gravel, and boulders? Mr. Waldorf says, because of the great grinding action of the water rushing down through the canyon, that 50 per cent of this silt originates within the canyon itself and 15 per cent comes in above the canyon. That is to say, 65 per cent of it passes through the Grand Canyon. This amount would make about one cubic mile in twelve years. It would all go into Boulder Dam. But that would not be all to go in. What is deposited on the delta is only a fraction, maybe only a small fraction, of what is passing through the mouth of the Grand Canyon and being deposited in the valley of the Colorado. This, by the way, according to what is said to be the cause of subsidence, may cause a subsidence of the whole valley, extending from the Gulf of California right up to the mouth of the Grand Canyon. Such material must be piling up near the mouth of the canyon at an enormous rate, backing up and even filling the lower part of the canyon itself. Boulder Dam would not only be filled with silt and gravel, as other dams are being filled; it would retain boulders weighing tons. Boulder Canyon is already filled to some depth with boulders from up the river, an enormous tonnage being swept down through the canyon at every flood. And Boulder Dam will get them all. At floodtime the carrying power of the water passing through the canyon is enormous. The water in some places is at times 100 ft. deep, running at 20 to 30 miles per hour—a velocity capable of moving immense boulders.

How fast will Boulder Dam fill? So fast, it seems to me, that it would be bad business to build it without first building a dam near the head of the canyon. Mr. Waldorf suggests above Lee's Ferry. The river at flood sometimes carries 200,000 sec.-ft. of water. A dam at the head of the canyon would insure a regular flow of 20,000 sec.-ft. This would reduce enormously the amount of silt and boulders that would otherwise be carried down through the canyon, making it possible to build a dam in the canyon without the prospect of it filling promptly with silt and boulders. The provision of a dam above would facilitate the construction of the dams below. WILLIAM CROCKER.

Prescott, Ariz.

The Passing of Mexico's Golden Mile

THE EDITOR:

Sir—Mexico Mines of El Oro, Ltd., has asked permission from the Department of Labor of the Mexican government to close down the greatest part of its underground operations.

This is doubtless but a preliminary to the complete closing down of the mine, although treatment of the tailing dump may continue for some time to come.

With the closing of this mine, there will pass from active mining the last property in the famous "Golden Mile of Mexico," occupied by Mexico Mines of El Oro, Ltd., on the north, Esperanza Mining in the center, and El Oro Mining & Railway on the south; all being located on the same vein system, that of the San Rafael and its lateral branches.

As the San Rafael vein is hidden by a thick andesite capping, it was overlooked during the early days of mining when the district was on the main route to and from the Tlalpujahua area, and the discovery was made in comparatively modern times. The story of this discovery most commonly told is that in the small-vein workings of the mine of the predecessor of El Oro Mining & Railway, the superintendent, being in need of waste for filling, drove a crosscut into the hanging-wall country and found the main vein. August Sahlsberg, the superintendent, noting the importance of the find, took up several claims to the north, where he judged the vein must extend.

One of these claims, where the Mexico shaft is now located, he sold for funds to start exploration on the Esperanza claim. The amount received, however, was not enough to get a shaft down through the capping, which was about 400 ft. thick. He sold a small amount of stock but not the control of the mine; and, with this money and the help of close friends, the shaft was sunk through the capping and into bonanza ore.

The Esperanza was pre-eminently a bonanza mine, although the total production of gold did not equal that of El Oro Mining & Railway.

The camp was one of the earliest users of the cyanide process, and many important additions to milling and cvaniding practice were worked out there. The mines and mills also furnished trial grounds for numerous men that either then or afterward became of note in the mining world, among whom the following are but a few:

Mexico Mines of El Oro, Ltd.,—T. H. Carter Mitchell, P. W. Avery, Genaro Garcia, Fergus Allen, and P. G. Spillsbury.

Esperanza Mining Company—Charles Hoyle, Frederick MacCoy, M. H. Kuryla, George T. Bridgman, and D. L. H. Forbes.

El Oro Mining & Railway Company—R. M. Raymond, Alfred Main, Herbert Enos, Huntington Adams, and Gelasio Caetani.

Prominent geologists, metallurgists and mining engineers who have done work of importance in the district include J. E. Spurr, H. V. Winchell, H. A. Guess, Waldemar Lindgren, and Pope Yeatman. A. B. MARTIN.

Mexico, D. F.

Geological Opinions

THE EDITOR:

Sir—In an article entitled "A Geologic Error Regarding the Wood River District," published in your issue of Aug. 25, 1928, the author, Stewart Campbell, makes the statement: "The recent extensive development work in the Minnie Moore mine, in the Wood River district, in Idaho, has proved beyond a doubt that the orebodies were formed prior to the intrusion of the diorite, and indicates that the sedimentary beds containing the lower end of the vein were elevated as a roof pendant, which was later removed by erosion."

Will Mr. Campbell kindly state the facts upon which he bases this conclusion? I am very familiar with the Minnie Moore mine, having visited it repeatedly during the recent campaign of exploration for the faulted segment of the oreshoot; and in my opinion the structure disclosed by this work affords no support to Mr. Campbell's statement, but, on the contrary, is in harmony with the conclusion of Waldemar Lindgren and others that the Minnie Moore vein, in common with other silver-lead veins of that district, was formed after the diorite intrusion. R. T. WALKER.

Salt Lake City, Utah.

THE EDITOR:

Sir—The theme of my article is "that the veins were formed at two separate and distinct geologic periods, and that the faulting of one vein may have no relation to that of another." In the preparation of this article all published statements lending weight to that theory were quoted. Mr. Waldemar Lindgren's conclusions were based on an examination made during August and September, 1898. If Mr. R. T. Walker would first contribute his facts and conclusions to the literature on this subject, I feel sure that a reply to his letter of Aug. 29, 1928, would then be much more appropriate. STEWART CAMPBELL.

Boise, Idaho.

Accidents, and the Choice of a Mining Method

THE EDITOR:

Sir—In a discussion of a stoping method economically best for a particular deposit or block of ore, the item of the cost of accidents is not always considered. If to the operating cost per ton of a shrinkage stope, say, is added the cost per ton of mining accidents, the total may be greater than the corresponding total for a top slice or a square-set stope. But even when the economic difference is in favor of the untimbered stope, it would seem to be desirable to take every precaution to avoid killing or maiming men. The endeavor ought to be not exactly the most economic mining but rather the most economic safe mining, and, indeed, this last may also be the first.

Under average conditions—that is, ground of medium toughness, without an excess but not with total absence of slips and fracture planes and of not uncommon stope dimensions—the decreasing order of degree of safety in mining methods is: top slice, square set, cut-and-fill, caving, and shrinkage, mentioning only the main types. In nearly ideal ground—that is, hard and tough, that has a minimum of slips and fractures and hangs well—of course a shrinkage or a combination in which shrinking enters may be as safe as any method and there may be no valid reason against its preferment, but ordinarily shrinking is the least safe, there being in this operation no stable floor in which to place timber to support the back even in an emergency.

Safety engineers forget that mining is conducted for a profit—a maximum profit—and ignore economics for the sake of safety. On the other hand, mining engineers are likely to forget to consider safety and to overlook the fact that a safe method may also be the most economic in the end, since accidents cost money. The recommendations of both can be combined, resulting in most economic safe mining.

Considering safety and economy for the main type of stopes the following criteria apply:

1. A top slice has overhead a more or less elastic mass, the timber mat. It will give ample warning before it caves down into the stope by the gradual failure of the stull supports or perhaps of the unsupported panels of the flooring of the previous slice. It is unsafe, however, when it projects beyond the limits of the slice above into unfloored ground. Methods have been developed of recovering some of the timber in comparative safety. The following suggestion probably has not been tried and is now made: A top slice on a small inclination from the horizontal—say 10 degrees; the stulls would be vertical but safely secured at the foot with anchored wedges opposing the resultant of the force tending to cause a slip down the incline. By pulling the anchors and wedges when ready, stulls would be recovered, letting roof panels down one at a time. The broken ore in the stope would not roll into the chute, but the small inclination of the floor would ease considerably the work of a scraper for mucking.

2. A square set is less safe than a top slice because there is not in the application of this method an elastic mass overhead. A weak back can be safely supported, except during the time a set is being erected. In moving ground, or where walls are weak, diagonal bracing and prompt filling strengthen the sets. Robbing timbers cannot be accomplished with much safety except in those operations in which square setting was not absolutely needed anyway. A square set must be chosen for other considerations than economy and safety.

3. A cut-and-fill is for ground that hangs rather well. It may be inclined or horizontal and of dimensions to fit the conditions, keeping in mind safety and economy. The back can be supported at any time when suspected by stulls and head blocks or by cribbing, and rendered safe. When or if slips and fracture planes appear, so that cut-and-fill mining is no longer safe, square setting may be started on top of the last fill. When too many stulls or cribs must be used, the feature of economy decreases. An incline cut-and-fill is less safe than a horizontal, on account of the difficulty in moving about, and its economy is less than it would seem to be, taking into account the difficulty of handling timbers, machines, and material on an inclined floor.

4. The different caving methods are alike in the respect that all depend upon the lack of coherence in the rock mass, so that it will cave down continuously as it becomes unsupported underneath. Once drawing from the chutes starts, it may be classified as safe if the timbering in the haulage levels can be kept in repair. When in the stage of preparation, however, the ground may be so loose that very unsafe conditions obtain. Undercut openings of minimum dimensions timbered with small sets increase safety. The economy of the method is obvious, but its application is limited to "caving ground."

5. A shrinkage stope must be considered as the most unsafe. It is like a cut-and-fill, but without a stable floor, as has been said. Emergency timbering of top of the ore fill cannot be used without stopping drawing from the chutes below; and when this has to be done frequently the economy of the shrinkage is lost. Continuous barring down helps much, but in broken ground with fracture planes running at different angles barring may be a very dangerous operation, and at times in such ground no amount of barring down will make it safe. There also exists the danger of being sucked into the vortex of a chute. In favorable ground, shrinking in sections with substantial pillars between may, of course, be economically and safely conducted.

FERNANDO MONTIJO, H.
Cananea Consolidated Copper Company, S. A., Cananea, Sonora, Mexico.

Locating Mineral Claims on Indian Reservations

"Will you advise me of the present situation regarding the locating of mineral claims on Indian reservations in the United States?"

The Commissioner of Indian Affairs is authority for the following:

"Unallotted lands on Indian reservations in various states are subject to prospecting, location and lease in accordance with Section 26 of the act of June 30, 1919 (41 Stat. L. 31) as amended Dec. 16, 1926, and the regulations prescribed thereunder. Under this act the lands are opened to any citizen of the United States desirous of prospecting and locating mining claims thereon. Should valuable metalliferous or non-metalliferous minerals not including oil and gas be found, locations of mining claims are to be made in the same manner as mining claims are located under the mining laws of the United States. A duplicate of the location notice should be filed with the superintendent in 60 days and an application for lease made within one year after the date of location, as these are mandatory requirements of the law."

Complete and detailed information on this subject is contained in a pamphlet entitled "Regulation to Govern Prospecting for and Mining of Metalliferous Minerals on Unallotted Lands of Indian Reservations," which may be secured from the Commissioner of Indian Affairs, Department of the Interior, Washington, D. C. Anyone contemplating the locating of claims on Indian reservations should secure a copy of this pamphlet.

Consultation

Iron Oxide for Pigments

"What mesh must iron oxide, for paint and pigment use, be passed through in order to make it a first-class marketable product? Can the very fine material be separated by blowers or must it be water washed and separated in settling tanks?"

Trustworthy authorities inform us that iron oxides for pigment purposes are ground to various degrees of fineness, ranging from 150 to 325 mesh, depending upon the purpose for which the mineral is to find specific utilization. The consumption of the various grades of oxide is relatively small in any one industry or group of industries, but there is no relation between the quantity consumed and the specifications for fineness—in some instances the industries that consume the smallest quantities require the maximum fineness. Control of fineness of pigment particles varies widely, depending upon the type of oxide used. In some instances water levigating processes are used, and in others adequate separation and control can be maintained by the various air-separation equipment units on the market, such as the Raymond mill.

INDUSTRIAL PROGRESS

Recent Developments in Ball-Mill Design

New Unit, Producing Finished Product, Has Several Unique Features

By J. R. Kueneman
Straub Manufacturing Company, Oakland, Calif.

AMONG the essential requirements for a ball mill may be included the following:

1. Crude ore must be easily fed into the mill.
2. Large pieces of ore must be crushed with large balls.
3. Small pieces of ore must be pulverized with small balls.
4. Finished particles must be carried away immediately after the required degree of comminution has been reached.
5. Oversize particles must be returned promptly into the mill for regrinding, not merely retained at the discharge end.
6. The screening or sizing device must not be subjected to wear from large ore particles, and it must be instantly detachable.
7. No small slots or passages should exist within the mill.
8. All small wearing parts should be simple and easily renewable, at small expense and without dismantling the mill.
9. The mill must be strongly constructed, of the least possible weight; hence it should be of steel, not cast iron.
10. It should use a minimum of power and occupy the least possible space.
11. First cost, and operating cost, must be reasonable.
12. Outside classification should, if possible, be unnecessary.
13. Every part should be easily accessible.
14. The mill should be suitable for crushing wet or dry.

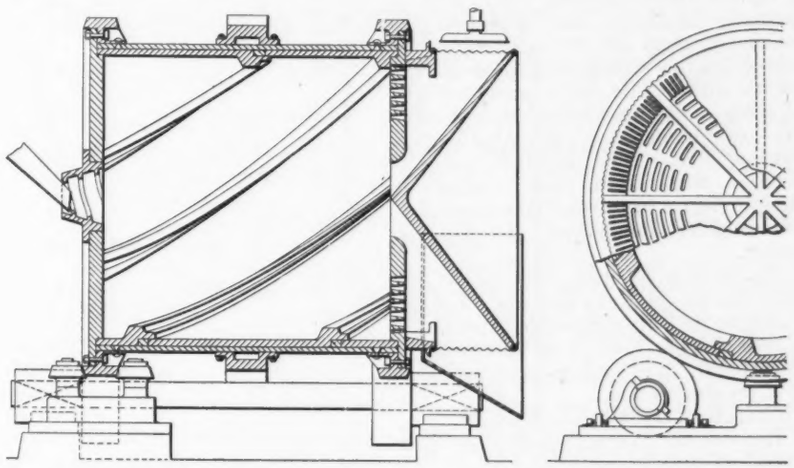
The accompanying sectional view shows the extent to which the foregoing requirements are attained in a new mill, to be known as the Rib-Cone mill, which consists of a heavy steel shell, fitted with hard-steel tires and revolving freely on the support wheels, rollers being used to keep the mill central upon the wheels. Power is applied through a ring gear in all mills more than 3 ft. in diameter, the smaller mills being driven by a wide belt running directly upon a pulley bolted to the shell. The heads and liners carry no weight or driving strain. They merely serve to retain the balls.

The shell of the mill is protected with readily removable liners. Between each is fitted a heavy spiral rib, or lifter, which is made with a reverse curve, so that when the mill is rotated in the proper direction, the balls are not only carried up, but are also thrown and conveyed backward toward the feed end of the mill, each sloping rib acting as a plow as it emerges on the ascending side, shoveling the ball charge away from the grid. This keeps the grid unobstructed, permitting the free passage of pulp through the large openings. Another striking advantage is that the larger balls tend to penetrate through the charge and thus to congregate at the feed end, so that the big pieces of ore are broken by the big balls, and the partly crushed small rock is pulverized by the small balls.

It has been noted also that as the balls are thrown both across the mill and toward the feed end, they promote, as they move forward again along the bottom of the mill, a definite flow of pulp toward the discharge grate. Actual demonstration shows that a continual shower of balls is hurled against the feed head, the charge being piled up there.

It is also to be noted that, because the balls are kept away from it, the grate head is not subject to wear. The openings maintain their original size. These openings are usually much larger than the size of the rock being fed to the mill, as any large material going through is promptly returned, by the oversize return device. This prevents clogging and permits a tremendous circulating load within the mill itself.

A large hole is provided in the center of the grid for the return of the oversize. The oversize-return device consists of a simple circular casting of hard steel, composed of a draining apron, a cone, and the lifting ribs which join the apron and cone together into one solid piece, with openings around the outside rim. Over this the finishing screen is securely clamped. The entire assembly is bolted to and revolves with the mill.



Sectional and end views of new ball mill, showing structural features

The draining apron is made with a lip or dam. This dam is not continuous, but is made with gashes or deep grooves, which extend down into the body of the apron, the bottom of these grooves sloping steeply toward the screen. It will be seen that as the mixture (of small rocks, sand, and water) pours through the grate, it falls into the apron, the small oversize and fine sand rapidly draining off through the grooves onto the screen, while the lip or dam retains the coarse oversize, thus preventing wear on the screen. As the ribs or vanes sweep around in their travel, all the oversize retained on both the apron and the screen is carried up to the top of the mill, to fall down onto the cone and to pass thence into the mill again.

How effectively this simple device operates may be judged when the screen is taken off and the mill is operated without it. When this is done, only a negligible amount of material larger

than 6 mesh passes through the openings covered by the screen, proving positively that the draining apron functions perfectly. This severe test was made with holes in the grid one inch wide, or twice as large as the ore fed to the mill. It is clearly apparent that a screen will work perfectly under such ideal operating conditions. In ordinary milling practice, the water is fed onto the screen near the top, thus effectively cleaning and washing it with a reverse current.

This method of feeding water is most satisfactory, because it permits a thick pulp and maximum grinding effect within the mill, diluting only the pulp that is close to the grid and on the screen. When it is desired to maintain an extremely high density pulp within the grinding chamber, the position of the screen washer nozzle may be changed accordingly, so that the wash water merely dilutes the pulp between the lower ribs or vanes and promptly flows out again, carrying with it the sized product. Thus the wash water does not enter and affect the density of the charge of the pulp within the mill.

A striking feature of the new unit is its extreme simplicity. Every part is instantly available for inspection by looking through the feed opening, or by taking off the detachable screen—a moment's work. The mill is made entirely of steel, no cast iron being used. Liners are of manganese or high-carbon chrome steel. The superior material used in construction saves weight; it saves expense in transportation; it permits smaller foundations, and it saves power.

The following data refer to a run of a test-model Rib-Cone mill, 3 ft. in diameter by 2 ft. long—belt driven.

Ball charge: 1,000 lb. at 32 r.p.m.

Material, hard quartz, precrushed in jaw breaker to $\frac{3}{4}$ in.

Capacity per 24 hours, tons, 16.

Horsepower to start, momentary load, including countershaft, 10.

Horsepower to run, including countershaft, $5\frac{1}{3}$.

Mill screen aperture: 35 mesh.

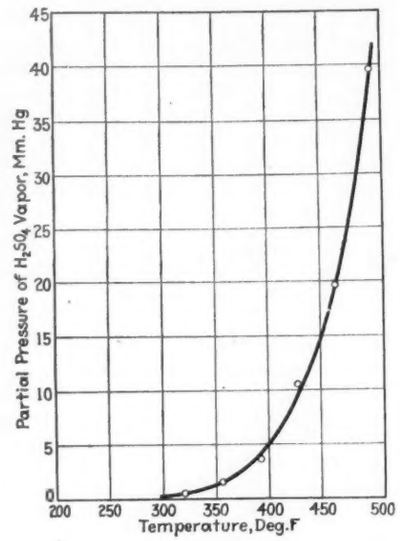
The Rib-Cone mill is also being manufactured without screen discharge, for operation in plants not requiring a screened product or for exceptionally fine grinding.

Alloy Steel Company Formed

Incorporation of a new company, known as the Timken Steel & Tube Company, which will take over the manufacture and selling of Timken steel and tubing, has just been announced by the Timken Roller Bearing Company. Headquarters and mills are in Canton, Ohio, with sales offices in Chicago, Los Angeles, Detroit, and New York. Officers of the new company are H. H. Timken, chairman; M. T. Lothrop, president; J. W. Spray, vice-president; A. J. Sanford, vice-president in charge of sales; J. E. Daily, vice-president in charge of operations; and J. F. Strough, secretary and treasurer.

Condensed Sulphur Gases from Burning Coal Will Corrode Equipment

IT IS generally believed that sulphuric acid, water, sulphur dioxide, and small quantities of sulphur trioxide will not affect iron or steel appreciably so long as they are in the gaseous state, but any condensation on equipment will cause corrosion to some degree, according to J. F. Barkley, in Bureau of Mines Technical Paper No. 436, entitled "The Sulphur Problem in Burning Coal." Condensation occurs if the flue gas or a small portion of it is cooled to a sufficiently low temperature. To determine the temperature at which the water in the flue gases will condense—that is, the dew-point temperature—it is necessary to know the amount of water vapor present in the gases. This vapor content can be calculated quite closely from the usual data taken on a boiler test, viz., the coal analyses, the moisture in the air, and the dry flue-gas analyses. From these the percentage by volume of the water of the wet flue gases is calculated. Its partial pressure is then found by multiplying the total pressure in pounds per square inch of the wet flue gases (generally about atmospheric pressure) by its percentage by volume. The temperature at which this partial pressure becomes the saturation point may then be read directly from steam tables, which give the temperatures for the various pressures. At such a temperature, if sulphur dioxide is present, it would be partly absorbed by the water and thus form a corrosive liquid. If sulphur trioxide is also present, the dew-point temperature would be somewhat changed. Present knowledge regarding the action of sulphuric acid vapor may be stated as follows:



Partial pressure-temperature curve of sulphuric-acid vapor (H_2SO_4) for acid of 98.3 per cent concentration

As the flue-gas temperature drops, the sulphur trioxide gas begins to unite with the water vapor, forming sulphuric acid vapor, until at the boiling point of concentrated sulphuric acid (about 620 deg. F.) practically all of it is united. This acid vapor condenses in the same way as water vapor. On condensation it first appears as an acid of 98.3 per cent concentration, which becomes diluted by the absorption of water upon further cooling.

A method, much the same as that used for the water vapor, may be used for determining the temperature at which the acid condenses. It is necessary to find by chemical analyses the amount of sulphur trioxide present. One volume of sulphur trioxide forms one volume of sulphuric acid (H_2SO_4). This should be expressed in per cent by volume of the wet flue gases. Its partial pressure is calculated as is the water-vapor partial pressure by multiplying the total pressure of the wet flue gases by its per cent by volume. Instead of using the unit, pounds per square inch, in this case, millimeters of mercury is somewhat more convenient in avoiding small decimals, the total atmospheric pressure being about 760 mm. The accompanying curve gives the dew-point temperatures for the different partial pressures of the acid. This curve is taken from the work of Thomas and Barker, published in the London *Chemical Society Journal*, Volume 127, No. 2, 1925, page 2820, and included in the International Critical Tables. The curve is not as accurate for the lower values as the steam tables used for the water, but it is probably sufficiently so for this purpose. As an example, when coal having 3 per cent sulphur and average moisture and hydrogen is burned to a flue gas of about 12 per cent carbon dioxide, if we assume that as much as one-third of the sulphur appears as sulphur trioxide, the dew point of the acid formed would be about 310 deg. F.; the dew point of the water vapor, disregarding the sulphur trioxide, would be only about 92 deg. F.

If the temperature of corrodible surfaces in contact with flue gases is below the computed acid dew point, there exists the possibility of corrosion from this source. Conditions for corrosion are especially favorable when equipment is taken out of service. Soot and other accumulations on equipment absorb the sulphurous gases. Their corrosive action is especially noticeable when moist. Trouble of this nature has been experienced with economizer tubes.

BULLETINS

MANGANESE STEEL—American Manganese Steel Company, 330 No. Michigan Ave., Chicago. A pamphlet entitled "The Manganese Steel." Twenty pages.

LUBRICANTS—Acheson Graphite Corporation, Niagara Falls, N. Y. A 66-page catalog entitled "Industrial Lubrication" describing 60 different types of so-called Gredag lubricants.

NEWS OF THE WEEK

Summary

TIN continues to attract most of the attention on the London metal market. The tin-plate industry is reported in a particularly good condition, with a new plant to be erected in Wales. Page 468.

* * *

American Mining Congress, the A.I.M.E., and the Mining Section of the California Development Association held a joint meeting at Los Angeles on Sept. 10-13, which was attended by delegates from all the Western mining states. Page 469.

* * *

Treadwell Yukon has optioned Yellow Pine Mining, at Goodsprings, Nev. This property is a silver-lead-zinc producer. Page 467.

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Calumet & Arizona and the Phelps Dodge Corporation have filed a brief with the U. S. Circuit Court of Appeals dealing with the Carson patent litigation. Page 467.

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Federal Judge F. E. Kannamer has upheld the action of former Secretary of the Interior Fall in leasing Quapaw Indian lands in Oklahoma to Eagle-Picher Lead. Page 467.

* * *

Lake Shore Mines has obtained a more favorable rate for electricity used in operations at its mine in the Kirkland Lake district from the local power company. Page 468.

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Hollinger Consolidated has made a final cash payment of $70,000 on the Jameson property, in the Kamiskotia district of Ontario. Page 467.

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Anaconda Copper is unwatering the Orphan Girl shaft, in the western part of the Butte district, preparatory to starting an extensive development campaign. Page 466.

* * *

Marquette Ore is suing North Range for $1,500,000 damages. It is alleged by the plaintiff that it leased an iron-ore mine from the defendant as the result of misrepresentations made by the latter. Page 466.

Ely, Nev., the center of one of the state's important mining districts.

Consolidated Coppermines Pushing Construction and Development Work

Operations at Kimberly, Nev., on Larger Scale Than at Any Time Since the War Period—New Steel Headframe at Emma Nevada Shaft Nearing Completion

SURFACE construction and underground development, preliminary to a general expansion of operations, are being pushed at the property of Consolidated Coppermines at Kimberly, Nev., 9 miles west of Ely. More than 700 men, the greatest number under employment since the war period, are on the payroll. Current production, averaging 2,500 tons of ore daily, is coming from the 360 level at the Morris No. 2 shaft in the western part of the property.

The vertical Emma Nevada shaft is now being equipped for large-scale production, to begin early in 1929. Sinking of the shaft was completed in 1927. It is 767 ft. deep; measures 32x7½ ft. outside of timbers; and has five compartments, two of which will be used for skips, one for a cage, one for a cage counterweight, and one for piping and a manway. Concreting of the shaft from the bottom upward is in progress, and has reached the 647-ft. point. The ore and waste pockets, at this level, have also been concreted. Surface plant at the shaft consists of a 155-ft. steel headframe and ore bins, and several fabricated-steel buildings, including a hoist house, blacksmith and machine shops, timber-framing building, change house, and warehouse. Headframe, ore bins, and buildings are being erected by the Kansas City Structural Steel Company. Hoisting equipment for the shaft includes a Nordberg double-drum hoist operated by a direct-connected 900-hp. General Electric synchronous motor. A PRE-2 Ingersoll Rand compressor of 4,000 cu.ft. capacity is also being installed.

Retimbering of the Alpha shaft, preparatory to unwatering the workings in that section of the property, has been started. It is expected that pump installations will be completed by the end of the year. Equipment consists of two DeLaval centrifugal pumps of 1,200 g.p.m. capacity under a 1,200-ft. head; one Allis-Chalmers centrifugal unit of the same capacity under a 200-ft. head; and a Worthington deep-well type pump of 1,200 g.p.m. capacity and an effective head of 200 ft.

Unwatering of the shaft will begin at the 1,000 level, where the two DeLaval units will be temporarily installed. When the water level has receded below the 1,200 level, one, and eventually both, of the DeLaval units will be moved to this level. The Allis-Chalmers unit will be permanently installed on the 1,400 level, when it is reached. In the course of the unwatering operations the Worthington pump will be lowered into the water and connected to one of the DeLaval pumps, but on completion of the unwatering this unit will be removed, the other units comprising the permanent pumping equipment.

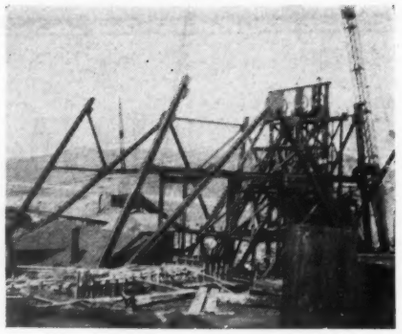
When the shaft is opened it is expected that mining of the oxide ores near by will provide an important part of the company's production. Deepening the shaft to prospect for underlying secondarily enriched sulphide ores, which are confidently expected to be found at depth, is being considered. The Alpha section was under develop-

ment during 1914-20, but operations were suspended because of the water. Steam power was then used at the shaft, and pumping costs as a result became excessive. As electric power is now available throughout the property, operations at the shaft can be undertaken on an economical basis.

At present development is under way on the 360 and 570 levels of the Morris No. 2 shaft and on the 457 and 647 levels of the Emma Nevada shaft. A branch-raise system of block caving is in general use in mining operations. This system has enabled the company to extract completely ore of a predetermined grade, with little or no dilution of wall waste.

The major development of the block units employed with the system consists of extraction laterals driven beneath the ore to be mined. The horizon of these laterals is so selected that the vertical distance to the ore does not exceed certain economical limits. Pony sets are then installed above the drift sets of the extraction levels, and, next, the main leg of the cribbed raise and its tributary branches are driven and completed. At the top of each branch of the cribbed raise a square set is erected, from which the "draw" of the ore is controlled. On the top sides of the square sets, finger chutes only a few feet in length are driven, and a grizzly is placed in the bottom of each set.

Undercutting and caving of the ore is accomplished by connecting the tops of all the finger chutes, and leaving small pillars that eventually crumble under the overlying weight, or as a result of blasting in the final retreat in this preparatory work. Ore is then drawn in as even a manner as possible, heavy drawing from one or more chutes being avoided, as this tends to produce a funnel to the overlying waste, which fills the funnel and dilutes the ore.



Rapid progress is being made in erecting the 155-ft. steel headframe at the Emma Nevada shaft of Consolidated Coppermines

Hurried, even drawing of ore gives the best results; little dilution occurs, and the crushing effect of the caving ore is constantly relieved, thus avoiding the destruction of the mining chamber.

Cribbed raises at 25-ft. intervals, making the drawpoints of the chutes 12½ ft. apart, have been generally used, but blocks of ore with raises at 30-ft. intervals, and drawpoints at 15 ft., are now being developed. It is believed that this latter spacing will draw the ore as effectively as the closer spacing, and reduce the raise development by one-fifth. The system used is an adaptation of that developed by Nevada Consolidated Copper at its adjoining property. A description of the system appeared in the May 21, 1921, issue of *Mining and Scientific Press.*

The above facts were courteously furnished by the Kimberly (Nev.) staff of Consolidated Coppermines. Officials are: J. B. Haffner, general manager; C. I. Cook, superintendent; J. A. Richards, assistant superintendent; P. J. Sirkegian, chief engineer, and E. N. Pennebaker, chief geologist.

St. George Mining Re-equips Aërial Tramway

St. George Mining, operating the St. George mine and mill and the Mineral Chief mine, on Democrat Mountain, in the Georgetown district of Colorado, has re-equipped its 900-ft. aërial tramway, connecting the Mineral Chief mine with the mill. Two buckets are now in operation, each of 1,800 lb. capacity. The company is considering reopening the Lynn mill to treat ores from the Mineral Chief, as the capacity of the St. George mill, which uses flotation methods, is limited to 75 tons of silver-gold-lead-zinc ore daily.

Dome Options Chibougamau

An official announcement has been made by Alexander Fasken, secretary of Dome Mines, Ltd., that the company has taken an option on the properties of Chibougamau Prospectors, Ltd., in northwestern Quebec, consisting of 153 claims, with a total acreage of 6,210 acres. According to the agreement, Dome will provide a sum somewhat less than $100,000 for development work, to be completed by the end of 1929, after which payments amounting to $500,000 will be due. Two Dome engineers will be in charge of operations.

Phoenix Unwatering Finished

Unwatering of the Phoenix incline shaft in Keweenaw County, Mich., undertaken by Calumet & Hecla as part of its exploration program, has been completed and a plat is being cut at the bottom. Exploratory work will soon be under way, both at the Phoenix and at the Cliff mine, which has been unwatered for some time.

Katherine Gold Starts Drills

Katherine Gold Mining, in the Kingman district of Arizona, is drilling the territory from the 900 level in an endeavor to pick up the offset of the main vein, which has been thrown out of its regular strike by a fault, possibly more extensive than those above. The first hole is being drilled in the southern part of the territory and is reported to be in 350 ft. horizontally already.

Marquette Sues North Range for $1,500,000

A CIVIL SUIT was started in Duluth, Minn., on Sept. 10, by the Marquette Ore Company against the North Range Company and its officers—D. R. McLennan, Lake Forest, Ill.; Robert M. Adams, Duluth; and Ward Ames, Duluth—over the leasing of an iron-ore property in Crow Wing County, Minn. In 1919 North Range transferred the lease to the plaintiff, who alleges that the defendants misrepresented the property, the grade of ore, and the amount of ore that could be mined at a profit. Marquette Ore wants $1,500,000 damages for money spent for shafts, railroad tracks, washing plant, and other equipment necessary to handle iron ore.

The defendants, it is stated, informed the plaintiff that 6,000,000 tons of ore could be mined at a profit, when less than 1,000,000 tons was actually extracted.

Anaconda to Deepen Shaft at Orphan Girl

According to an announcement by J. R. Hobbins, vice-president of Anaconda Copper, at Butte, Mont., the Orphan Girl shaft, in the western part of the Butte district, will be deepened to 2,800 ft. At present the shaft is 1,000 ft. deep. Unwatering of the workings is already in progress, and when completed sinking will be started immediately.

An aggressive campaign to develop the zinc orebodies known to exist in the Orphan Girl territory will be undertaken. Four years ago, the Orphan Girl mine was equipped with one of the most complete surface plants in the Butte district.

Tom Reed Builds Tramway

Construction of a tramway at the Tom Reed mine, near Oatman, Ariz., is expected to be finished within two weeks. Machinery has been placed in the winze on the main oreshoot, and the drift from the 800 level of the Black Eagle shaft will be continued through the ore to the United American boundary line. This development is expected to increase production so that the mill may be operated on larger tonnages. After the flow of water recently struck on the 900 level of the Black Eagle is under control, the shaft will be sunk to the 1,100 level.

Tough-Oakes Mill Resumes

The mill at the Tough-Oakes mine, in the Kirkland Lake district of northern Ontario, is again operating and is now treating approximately 175 tons of ore per day. The Tough-Oakes shaft is down to a depth of 1,975 ft., and a station has been cut at the 1,900 level. The shaft entered a vein, 6 ft. wide, at a depth of 1,950 ft. Damond drilling is being carried on in the northern section of the 1,600 level.

The McGill (Nev.) plant of the Nevada Consolidated Copper Company

Nevada Consolidated Erecting New Stack and Cottrell Unit

CONSTRUCTION of a new brick stack and a Cottrell plant to replace the existing flue system and stack at the McGill (Nev.) smelter has been started by Nevada Consolidated Copper. The new stack will be 350 ft. high and will have a uniform inside diameter of 20 ft. It is expected that the stack will be completed about Dec. 1. Construction of the Cottrell plant, which will be a plate type unit, will continue throughout the winter.

Arizona Companies File Brief in Carson Patent Case

A BRIEF, setting forth reasons why the verdict of the U. S. Court of Appeals in favor of the Carson Investment Company and against Anaconda Copper should have no bearing on the suit brought against Phelps Dodge and Calumet & Arizona in the local court, has been filed by these two companies with the U. S. Circuit Court of Appeals at Tucson, Ariz. In filing the brief, the attorneys declared that "justice and equity should be done and the rights of the defendants measured not by generalities of precedent, but by the conscience of the court." The brief totaled 112 pages in length. Judge William Sawtelle has had the local case—one of several brought against copper companies in which infringement upon a patented reverberatory furnace used in smelting copper is charged—under advisement for several months.

Anaconda Copper has again appealed from the decision of the Ninth Circuit Court of Appeals in a similar suit brought against it by Carson Investment, and the litigation will be brought before the Supreme Court.

Hollinger Makes Final Payment on Kamiskotia Mine

Hollinger Consolidated has made the final cash payment of $70,000 called for under the terms of its option on the Jamieson property, in the Kamiskotia area of northern Ontario, making a total of $150,000 paid in cash for an 82½ per cent interest in the property. The completion of this transaction is regarded in Toronto circles as assuring the future of the Kamiskotia copper-gold district.

Hollinger ceased development operations at Kamiskotia late in June, leaving only a force to keep the workings unwatered.

May Reopen Michigan Mine

If Mohawk Mining decides to reopen its Michigan mine, in Ontonagon County, Mich., it will probably sink the main shaft, on the Butler lode, an additional 1,200 ft., as has been recommended. At the time the mine was closed down, in 1920, the shaft was sunk to a depth of only 879 ft. The yield was 23.25 lb., refined, but production was curtailed by a lack of sufficient openings. In addition to the Michigan, Mohawk Mining owns a tract of 320 acres, west of Wolverine, which offers possibilities of perpetuating the life of the company when its producing properties in Houghton and Keweenaw counties are worked out.

Lease of Indian Mining Lands in Oklahoma Upheld

Federal Judge F. E. Kannamer on Sept. 10 upheld the action of Albert B. Fall, former Secretary of the Interior, in leasing mining lands belonging to the Quapaw Indian reservations, near Picher, Okla., to the Eagle-Picher Lead Company and dismissed the bill of complaints asking for their cancellation. The lands are within the Tri-State lead-zinc mining district.

Treadwell Yukon Options Yellow Pine, in Nevada

AN OPTION has been taken on the property of the Yellow Pine Mining at Goodsprings, Nev., by Treadwell Yukon, which also owns a property at Tybo. Both Yellow Pine and the Tybo properties are silver-lead-zinc mines. Yellow Pine has a record of production and operation since 1892 and has been the principal property in the Goodsprings area.

The option price is reported to be $300,000; all ores and concentrates produced during the option will apply on the purchase price. Treadwell Yukon will begin mining operations within 60 days, and has agreed to spend $100,000 during the period of option. Yellow Pine retains its name, as it has other property in the district and elsewhere. A. V. Udell, manager of Atolia Mining, was chiefly responsible for making the purchase and will be manager of the new operations while continuing his work at Atolia.

The entrance of Treadwell Yukon into southern Nevada is regarded as especially significant and important to Nevada. as the company has the backing of Bunker Hill & Sullivan Mining & Concentrating.

Report Progress in Forming Quicksilver Cartel

Advices from Spain indicate that complete details of the Spanish-Italian quicksilver agreement have not been worked out, but that it has been decided to peg the price at the equivalent of $127 per flask and to establish quotas under which Spain will supply 60 per cent of the orders reaching a common sales office, which will be established in Monaco, London or a port in Spain. The exact location of the office is to be determined later. The agreement is to continue for three years with an option of continuing it for three years more if desired.

Dickens Shaft Sunk to No. 6 Level

The main shaft at Dickens Consolidated, in the Cœur d'Alene district, has been sunk an additional 200 ft. to the No. 6 level and a station has been cut at that point. Skip pockets on the No. 4 and No. 5 levels have been enlarged to 150 tons' capacity, in preparation for production. The oreshoot on the No. 5 level has been developed for a length of 250 ft. east of the shaft. The company's new concentrator is nearing completion and will probably be started about Oct. 1.

London Letter

By W. A. Doman
Special Correspondent

Tin Continues to Be Chief Center of Interest in the London Metal Market

London, Sept. 4, 1928.—Only yesterday I learned that some very important people in the tin trade regard the present price of about £212 as much too high. The position of the metal is one, it is said, induced by the producers themselves in increasing the number of dredges and thereby creating a supply that is in excess of demand. Tin, even at £200, would be too high! The tin-plate industry seems to be flourishing, for, according to report, an order has been placed in South Wales for 1,000,000 boxes, or roughly 60,000 tons of tin-plate, to supply the oil containers for the Eastern trade, the value of the contract being £900,000. A new tin-plate works is to be erected at Gurnos, in the Swansea Valley, and work will be started at once.

THE TIN areas in East Africa owned by the Tanganyika Goldfields group are to be intensively developed, with the co-operation of the Billiton-Maatschappy, of The Hague, Netherlands. The cost of prospecting will be borne by the Dutch company, which will receive half of any profits made.

It is announced from Johannesburg that the chemists attached to the Central Mining & Investment Corporation have solved the problem of platinum concentrates reduction, which, it is expected, will open up a profitable era for many platinum properties. Already the Chemical & Metallurgical Corporation is carrying out the treatment of platinum ores at Runcorn on a small scale, and the Minerals Separation is also experimenting.

A company has been registered for selling and distributing nitrate in England, Europe and Egypt; it is called the Chilean Nitrate of Soda Distributors, and has a capital of £10,000 in £1 shares. The directors are: T. T. Aikman, of Aikman (London), Ltd.; G. E. Korn, of Antony Gibbs & Son; F. Petrinovic, of the Lautaro Nitrate Company and of Baburizza & Company, and W. Weir, of Andrew Weir & Company.

I have been making further inquiries about the coming conference of lead producers, but although headquarters have been attacked, little additional information is obtainable. The sum of it is this: The conference will take place in London on Sept. 17, under the presidency of Sir Robert Horne, the moving spirit in the matter. It appears that the reason the Spanish producers were not invited is that they showed no inclination to come in. Even the Penarroya has not yet sought to be included. The list of companies that will be represented is ready, but it will not be handed out for publication yet. San Francisco Mines of Mexico will, I understand, be represented, not directly by the Union Corporation, which controls it, but by the American Smelting & Refining Company. With hopes raised as to the result of the conference, lead shares are showing more signs of life.

Mexico City Letter

By W. L. Vail
Special Correspondent

Regulations on Export of Precious Metals From Mexico Are Changed

Mexico City, Sept. 9, 1928.—A new presidential decree has been issued with reference to the export of coin and bar metals. Under the law, all exporters of bar metals have been obliged to reimport in gold the equivalent of the metals exported by them. With a view to assisting the exchange, however, it has been decreed that within 30 days after the exportation, exporters may give the government the equivalent of the gold which should be reimported in a banker's check on New York or London. In addition, exportation of old Mexican coinage will be permitted with no other requisite than an examination at the border.

IN THE Sultepec district, State of Mexico, the Alacran y Anexas, which is one of the oldest working properties in the district, has applied to the mining department for permission to suspend mining operations permanently. The management states that the company has been operating at a loss for the last six years and that it is impossible to continue. Suspension would mean the discharge of about 200 men.

Reopening of the properties of Minas de Mexico, in the Sahuaripa district of Sonora, is being undertaken by an American syndicate. This is an old property which was worked extensively until the first revolution of 1910, when it was closed down. It has not been worked since, except for a short period in 1921, because of the unsettled conditions prevailing in the neighborhood. It is situated 45 miles northwest of Tonichi, the terminus of the Southern Pacific railroad branch line. There is a 60-ton mill on the ground

It is reported that British Metals has purchased a large block of stock in Mazapil Copper, operating mines in Coahuila and Zacatecas. It is also reported that the 300-ton lead plant of the company will be moved from Saltillo, in Coahuila, to Concepcion del Oro, in Zacatecas. The Saltillo smelter has been doing a custom business, as well as treating ores of the company. The unit consists of three blast furnaces and one reverberatory.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Lake Shore Mines Obtains More Favorable Rates for Electric Power

Toronto, Sept. 15, 1928.—Announcement has been made that Lake Shore Mines, in the Kirkland Lake district of northern Ontario, has signed a contract with the local power company for a supply of electric power for the life of the mine at $50 per horsepower-year. The signing of this contract ends, for Lake Shore at least, a fight for better and cheaper power started more than two years ago by the various mining companies. To date, the Kirkland Lake mines have been operating under an old contract, made when the district was merely a prospect and when a total of 500 hp. was expected to be the limit of requirements. On the basis of the old contract, the mining companies were paying approximately $65 per horsepower-year.

CONDITIONS at the Vipond mine, in the Porcupine district, have improved considerably as a result of new ore found on the 700 level. The vein has been drifted on for 170 ft. and averages 8.4 ft. in width. This strike is in a previously undeveloped section of the mine, and other levels are now being extended in the hope of intersecting an extension.

No. 2 shaft is being opened on the 300 and 400 levels at the Errington mine, owned by Treadwell Yukon, in the Sudbury district, and No. 3 is down more than 300 ft. Plans call for a crosscut to the vein from the No. 3 shaft at the 400 level. Diamond drilling at this point showed ore to a depth of 1,100 ft., the greatest depth reached by the drills.

At the adjoining Sudbury Basin mine, diamond drilling continues to give favorable results. An orebody 1,000 ft. long and 30 ft. wide has been definitely proved. The last hole drilled cut 80 ft. of ore, of which 40 ft. carried 3 per cent copper, in addition to lead and zinc.

The west shaft at the Sherritt-Gordon, in northern Manitoba, is down 400 ft. and three levels are being established at 125-ft. intervals. At the east shaft a total of 600 ft. of lateral work has been done on the 125 and 250 levels. Drilling on the Oak property, situated near the Sherritt-Gordon and recently acquired by that company, is said to have indicated gross values of several million dollars already.

Crown Reserve, in the Larder Lake district, adjoining Kirkland Lake, is developing three new levels—the 925, 1,050 and 1,175. No. 1 vein has just been cut on the 925 level, where it is said to be 15 ft. wide. It is expected that this vein will be cut on the two lower levels within the next month.

Western Mining Convention at Los Angeles

Joint Meeting of American Mining Congress, A.I.M.E. and Mining Section of California Development Association Held Sept. 10-13

By G. J. Young
Associate Editor

THREE important mining organizations joined in a conference at Los Angeles, Sept. 10-13—the A.I.M.E., the American Mining Congress, and the Mining Section of the California Development Association. Philip Wiseman conducted the opening ceremonies of welcome, in which A. G. Mackenzie, of Utah; J. O. Carper, of Colorado; J. D. Conover, of the Tri-State area; C. Chester Brown, of California; W. B. Gohring, of Arizona; J. C. Kinnear, of Nevada; Frank M. Smith, of Idaho; Milnor Roberts, of Washington; and J. F. Woodbury, of New Mexico, participated. An inspiring address by Charles W. Merrill, of San Francisco, concluded the morning session. Mr. Merrill said: "It is my belief that no man present in this gathering has not a deep-seated and heartfelt desire that the prosperity of our industries be maintained." He touched upon the need for a national program to insure the prosperity and welfare of the mining industry; the necessity for a proper recognition of this industry. To counteract the increase in unemployed as a result of mechanization, he advocated the development of new lines of endeavor. He sketched the progress made in California in the growth of the mineral industry, and closed his address with a plea for a forward-looking and balanced program.

The luncheon was a gathering of old friends, with Edwin Higgins as toastmaster. A significant suggestion was made by Robert Tally, who remarked that efforts should be made at future meetings to include the younger element. E. P. Mathewson presided over the afternoon meeting. Martin Van Couvering sketched briefly present-day methods of conserving natural gas. J. B. Tenney's paper on the need for an electrolytic zinc plant in the Southwest showed the possibilities of additional industrial development and a new marketing outlet for zinc concentrates. Tenney appraised existing zinc-ore supplies, power requirements, and costs. He stated that there is a sufficient supply of actual and potential Western type zinc concentrates to justify the building of a plant, or several plants, with a total combined capacity of 200 tons per day. About half of this is already being produced at retort plants, so that the additional zinc that would be thrown upon the market would not be more than 114 tons per day. The most feasible location for such a plant would be Los Angeles, according to him.

In the ensuing discussions, J. F. Woodbury called attention to developments in zinc mining in New Mexico. A. A. Zentner pointed out the advantages that would result to a zinc plant placed in an industrial region where outlets could be found for surplus sulphuric acid and other byproducts. He commented on the superiority of electrolytic zinc, and the advantages of Los Angeles as contrasted with inland points. J. Kruttschnitt and O. C. Ralston contributed to the discussion.

David Hall, of Los Angeles, presented a paper on the motor-generator as applied in electrolyzing leaching-plant solution. Both the synchronous converter and the motor generator have been used for this service, but the latter has proved to be elastic in its application and capable of wide variations in voltage. H. W. Aldrich in discussing Hall's paper stated that the efficiency of the motor-generator sets at Inspiration has exceeded 92 per cent. He pointed out the advantages of such equipment in starting up a plant such as that at Inspiration and commented upon the ease with which the day-to-day requirements were satisfied.

In the absence of Charles A. Mitke, E. P. Mathewson called for a discussion of his paper comparing branch-raise and combined-shrinkage and caving methods of mining. F. W. Maclennan pointed out that the method of mining adopted must suit the particular orebody. A large proportion of the cost is involved in the preliminary work, which would be the same for 50-ft. backs as for 300-ft. ones. At Miami a 75-ft. back was used in mining the higher-grade ores; but, with the present-day low-grade ore, 300-ft. lifts are taken. The caving of high blocks and excessive ground weight entail difficulties in ore drawing. A block 150x300 ft. was first decided upon, but this proved to be too large, and the dimensions were cut down to 150x150 ft. Maclennan said that when the Miami orebody is undercut it caves well by itself. Instead of using shrinkage stopes to control the caving at the sides, caving drifts are used to establish partial weakening and a line of fracturing. Satisfactory results had been obtained in three years of operation.

Frank Ayer, of the Phelps Dodge Corporation, stated that the ore at Morenci is probably harder than any other ore now being worked by the caving system. Undercutting is restricted, to avoid dropping large blocks. A 16- to 18-in. grizzly bar spacing has displaced the 10-in. spacing once used, a notable increase in labor efficiency resulting. Last month the mining rate reached 76 tons per man, compared with 36 tons under the older methods. Safety ropes and safety belts are now being used to prevent accidents at the grizzlies. Partial shrinkage stopes are being used to control caving. W. Val De Camp, John Hodge, and E. D. Gardner added to the discussion. Frank Probert pointed out the need for precise terms in designating rock hardness.

In the absence of Irving A. Palmer, a general discussion followed the presentation of his conclusions respecting ore flotation. Frank Probert made an inspiring plea for the better understanding of flotation fundamentals. F. W. Maclennan, Dorsey Lyon, and Ernest Gayford added interesting comment on the rapid advances made in this important subject.

Western Division—American Mining Congress

Under Guy N. Bjorge, the Western Division of the American Mining Congress discussed mine-operating details on Tuesday, Sept. 11. J. B. Pullen, who presented his own paper, gave a description of the mine-ventilation work at the Copper Queen. The mine covers 520 acres, the stopes are scattered, the vertical range extends over 22 levels, and two mine fires (sealed off) are active in the working area. Two downcast shafts of concrete extend to the 1,800 level. Four blowers or fans, used underground, are tested twice a year, and the underground ventilation is under constant observation. A complete survey is made once a year, whereby satisfactory working conditions are maintained. Colcord Jones, in discussing Pullen's paper, described the introduction of the pressure system for the control of mine fires in sulphide orebodies at Iron Mountain, Calif., in 1902-1905.

Mr. Bjorge read J. S. Finlay's paper on the sinking of the North Lily shaft, of interest chiefly because of difficult ground. F. H. Hayes described the grouting-off of excessive water in recent shaft sinking at Bisbee. Charles F. Steinbach's paper on the use of scrapers in underground loading at the Ruth mine (Nevada Consolidated) was read by F. H. Hayes. E. P. Mathewson read Fred Hodges' paper on changes in the coarse-crushing and fine-crushing departments of the Hurley plant. F. W. Collins stated that the cone crusher represented the greatest advance in crushing machines since the large-diameter high-speed rolls had been introduced. Ernest Gayford called attention to the habit of thinking in terms of large tonnage plants. He described the use of the 4-ft. cone crusher at the Utah Apex mill and stated that this crusher has an important field in the 100-, 150-, and 250-ton plant. H. W. Aldrich described the roll plant at Inspiration. The application of the Herman mill as an intermediate crusher was also described.

Charles W. Merrill conducted the meeting of the mining section of the California Development Association

and directed attention to the three years' work of the association in coordinating the agencies in California having to do with the mining industry. Rush T. Sill presented a general paper on the mining industry of California, dwelling upon historic features and touching in detail upon the mining history of the southern countries. He said that the great bulk of the mineral wealth of southern California is in non-metallics. He mentioned Searles Lake potash, the borax developments, sillimanite near Bishop, the Ogilby cyanite deposits, gypsum, and talc. In closing he described unwatering operations at Bodie, where a unique application of oil-well equipment to mine drainage is in operation.

Walter Stalder commented upon the value of Prof. W. F. Dietrich's bulletin on the California clay industries. He spoke, also, about the need for a copper refinery in California. The extending of sympathetic support to the California Division of Natural Resources, in particular the mining division, was advocated. Need for topographic and geological mapping was stressed, and the desirability of planning road development in relation to available mineral deposits was suggested. The work of the Commonwealth Club of California was touched upon.

C. M. Redford read a paper by G. J. Sielaff, geologist of the Southern Pacific, in which he pointed out the need for new uses for non-metallics and the development of demand for California mineral products. Dean Frank H. Probert of the University of California stirred the meeting with an inspiring address—a message to the mining fraternity, admonishing it to sell its industry to the general public. He spoke about the ills of the industry and the importance of its place in the economic life of the country. In conclusion he said: "A public consciousness and interest must be aroused in the mineral industry because it ministers to personal and national peace, progress, and prosperity. Government policy, whether communal, state or Federal, should spring from the deliberate action of an informed electorate. To inform the people, to sell them the idea, to make them realize that mining is their business, as it is ours—this is 'our job.' I ask you to go to it with enthusiasm."

Western Division, American Mining Congress

Frank M. Smith presided at the Wednesday morning session of the Western Division of the American Mining Congress. A. J. MacLean's paper on the "Supply Department" was read by A. G. Mackenzie. MacLean is general purchasing agent of the Utah Copper Company. He advocated a modification of the perpetual inventory system and a greater simplification in supply accounts. He discussed turnover, stocks, and investments in supplies.

Robert Linton read T. McGrath's paper on "The Mine Manager's Cost-control Problem," which dealt with the economics of mining and covered the principal factors of cost control. Mr. McGrath stated that "the miner is not in a position to pass on increased cost of production by increasing the selling price. He must rely principally upon his own resourcefulness to wrestle the mineral from mother earth, to process and refine it, at a cost below the price that world demand may offer him."

G. N. Bjorge read James W. Wade's paper on "Co-operative Mining Development," which emphasized the economic gain possible by combining the resources of adjoining mining companies under conditions where independent action would lead to unnecessary duplication of exploration and development. This was worked out in the Tintic district successfully.

Gerald Sherman read H. H. Pratt's paper on "Diesel Engines as a Source of Power," giving the experience of the Phelps Dodge Corporation in the development of Diesel power plants for mining operations. J. D. Conover read George J. Stein's paper on the "New Central Power Plant of the Commerce Mining and Royalty Company," of the Tri-State region. This is also a Diesel plant and serves several mines in nearby areas. The plant was completed in August, 1927, and when started supplied 4,400 hp., but the power demand increased to 6,400 hp. in ten months.

H. S. Martin, of the Utah Copper Company, discussed in his paper the preparation and modification of ore pulps for flotation treatment. Grinding, pulp dilution, and the use of reagents were described. He stated that considerable research work has been done recently on the effect of hydrogen-ion concentration in flotation, and that there is a growing belief that the alkalinity of the pulp water should be determined thus, rather than in terms of total available alkalinity. Arthur Crowfoot, of Morenci, called attention to the experimental results he had obtained in the division of the pulp into primary slime and sand before final grinding, both portions being subsequently separately treated by flotation. He stated that preparations are being made at Morenci to apply the idea on a larger scale. H. S. Martin, of the Utah Copper Company, had also experimented with separate treatment of divided pulp. Ernest Gayford expressed the opinion that comparative costs would largely determine whether separate treatment would be advantageous. He said that it was a question that affects the copper concentrators rather than the complex-ore concentrators. George W. Thomas closed the meeting with a discussion of solution alkalinity in flotation.

Institute Holds Afternoon Session

Robert Linton conducted the afternoon session of the Institute. Robert R. Boyd, chairman of the Southern California Section, introduced President George Otis Smith. President Smith sounded a warning to the industry by tactfully pointing out the fact that mineral supplies are not inexhaustible. He said: "Optimism cannot add a barrel or a ton to nature's store of indispensable mineral fuels and ores, upon which we are making larger and larger inroads each year. I am glad to hear President Kelley of the Anaconda Copper Mining Company oppose those who profess unbounded faith in nature's continued generosity to America with the plain warning: To those who state that 'America has just started,' the uncontrovertible answer is that so far as our natural resources are concerned America is well on its way.'" Continuing, President Smith said, "Conservation—by which I mean use without waste—deserves to be a religion with mining engineers; not a religion to preach so much as a religion to practice."

The "Possibilities of Non-metallic Minerals in the Pacific States" was presented by George J. Young, who stated that the non-metallic mineral industries are well established and that sound engineering, research, and the combination of technical and business ability are necessary in the establishment of new enterprises in this field. He pointed out that initiative and inventiveness are necessary in bringing non-metallic enterprises on the market and that business organization is essential in merchandising.

Walter W. Bradley, state mineralogist of California, reviewed the non-metallic mineral industry of California. George Otis Smith commented on the significance of the growth of the non-metallic mineral industry as a better index of the advance of civilization than the metals. A paper on the important subject of some properties of Oil-Bleaching Clays was presented in abstract by C. W. Davis of the Bureau of Mines. Davis included methods of testing clays, properties under various conditions and the effect of acid treatment. The concluding paper of the session was a concise review of methods and conditions arising in the mining of clay deposits in California, by Prof. W. F. Dietrich, of Stanford University.

Concluding Session

Robert E. Tally, of the United Verde company, was chairman of the concluding session. G. H. Bailey, counsel for the American Mining Congress, reported the progress being made in obtaining an equitable adjustment of the depletion questions. Tally said, "As we know, mine taxation is one of the most important subjects confronting the industry. It is a complicated subject, due to the many types of mines and the difficulty of arriving at an equitable basis of taxing. The American Mining Congress is directing its efforts toward simplifying the methods of taxation, to make them as equitable as possible."

T. H. O'Brien, of Inspiration, stated that both he and his neighbors had mining property at Inspiration, and that mine taxation is an important question with them. Continuing, he said: "We pay 51 per cent of the taxes of the county, and I hesitate to state what portion of the state tax is contributed by the mines. Six or eight years ago, Inspiration was assessed for tax purposes at a value of about $81,000,000, since

when this sum has been reduced to $31,000,000; but we are paying more taxes than we did before." Mr. O'Brien pointed out the necessity of keeping public expenses down, and said: "Our taxes are a serious question, as we work rock as low as 11 to 12 lb. total copper per ton. Present taxes amount to ¾ to 1c. per pound of copper. We are unable to get anywhere with the politicians. If something could be done to educate the public and let the people know about actual conditions, it would be of benefit."

A. P. Ramstedt presented the taxation situation in Idaho and A. G. Mackenzie discussed taxation in Utah. Dean Probert and others contributed to the discussion. J. F. Callbreath discussed mineral tariffs and the work of the Mining Congress in this field. Robert E. Tally then said: "Stabilization has been difficult, as the commonsense adjustment of supply to demand has not been recognized. Stabilization is, as we view it, an adjustment of supply to demand at prices that will make the industry attractive, not only with the prospect of fair returns to the investors, but with a sufficiency also to stimulate research and new enterprise." In his opinion mining has not been made sufficiently attractive since the war. He suggested the need for legislative action to enable mineral producers to get together on a rational policy. The real cure for overproduction, in his opinion, is curtailment in accordance with demand and by co-operation between individual producers and the government.

A Mining Congress meeting would not be complete without reference to the blue-sky laws, and Secretary Callbreath scathingly and thoroughly hit this subject and found many sympathizers in the audience. The resolutions were then presented, and the following approved:

No. 1—Directs the American Mining Congress to appoint a committee to investigate geophysical methods of prospecting in relation to the present mining laws and to suggest changes in those laws that would give encouragement to such methods of prospecting.

No. 2—Indorses the proposed federal high-grade law.

No. 3—Refers to the withdrawal of public lands in national forests and takes a position against such withdrawals except when the lands in question have been found to be non-mineral by competent government examiners.

No. 4—Advocates increased appropriations for the U. S. Geological Survey and the U. S. Bureau of Mines.

Smelter Fumes Case Will Be Heard on Oct. 9

THE first hearing in connection with the investigation by the International Joint Commission of smelter fume damage near Trail, B. C., where Consolidated Mining & Smelting of Canada operates several large plants, will be held at Northport, Wash., on Oct. 9. On the conclusion of the hearings at Northport it is probable that a further hearing will be held at Trail.

The commission's notice of the hearing states that it is for the purpose of considering and securing all available information relating to damages to property in the State of Washington by fumes from the smelter at Trail, B. C. Continuing, the notice reads:

"It is requested that each claimant who has suffered damage by reason of such fumes shall file with the commission at said time and place a statement showing description of his land affected, whether timber or agricultural land, the kind of soil and state of cultivation, its use, and the nature of the injury and extent to which said fumes have affected the land or its products. All parties interested are entitled to appear at said hearing and present their views to the commission."

Will Drill Ajo Claims

Continental Diamond Drilling, of Los Angeles, Calif., has secured the contract for the diamond drilling of the 2,800-acre tract in the Ajo mining district recently optioned by C. Van Dyke, of Miami, and Hoval A. Smith, of Warren. Mr. Smith is assisting in the engineering work and management of the enterprise. The options are for four years.

Consolidated Cortez Silver May Treat Concentrates

Owing to a recent expansion in productive operations, the Consolidated Cortez Silver Mines Company is investigating the possibility of treating by leaching the high-grade silver-lead concentrates made at the company's property, situated at Cortez, Nev. Transportation costs in shipping the concentrates to the smelters are exceeding milling costs, and it is believed that a substantial saving may be effected through local treatment of the concentrates.

Big Blast at Alaska Juneau Breaks Ore for Ten Months

At Alaska Juneau Gold Mining, near Juneau, Alaska, a charge of thirteen tons of dynamite was recently fired. The resultant blast broke sufficient ore to keep the mill of the company running for ten months. The tramway is transporting a daily average of 12,000 tons of gold ore to the mill.

Orebody at Strattons Drifted on for 800 Ft.

The orebody on the 300 level, east of the shaft, at Strattons Mining, situated in the Coeur d'Alene district of Idaho, has been drifted on for 800 ft. with the width varying from 5 to 8 ft. wide. Some of the ore is said to be sufficiently high grade to go directly to the smelter. Shipments to the Hercules custom mill are now averaging about 60 or 70 tons of silver-lead ore daily. The mine is employing about 45 men.

President of Abana Mines Denies Rumors of Flooding

ALFRED SAVARD, president of Abana Mines, operating in the Rouyn district of Quebec, has issued a comprehensive denial of rumors that have recently been circulated about the company and its property. He denies that the mine workings have been flooded and declares there is no danger of such an occurrence. Mr. Savard also denies that the company has ever had dealings, directly or indirectly, with Consolidated Goldfields of South Africa, McIntyre-Porcupine, or New Jersey Zinc, and states that more comprehensive development, more power, better transportation facilities, and greater milling capacity are warranted by the present position and outlook.

Mill for Complex Ores at Sahuarita Is Almost Ready

Minerals & Metals Corporation, of Tucson, Ariz., expects to have its new mill at Sahuarita, Pima County, in operation within a short time, according to F. L. Dean, manager. The mill, built entirely of steel, will be made up of four units to allow any combination desired for treatment of complex ores. It will handle molybdenum, tungsten, and vanadium ores among others. In recent years, ore shippers from this district have been penalized for the zinc content in their shipments, but as the Sahuarita mill will make a zinc separation, this loss will be no longer necessary. The capacity of the new plant is stated to be about 35 tons a day.

Dredging Activity Increases Alaska Gold Output

Continued increase in dredging activities throughout Alaska has been reflected in a material addition to the gold output of the territory. August, 1928, shows a production of $739,293 of gold compared with $512,801 in 1927. Two districts that may develop into new dredging fields are Canyon Creek, where drilling has been carried on over a distance of 6 miles, with the result that there is a prospect of a dredging plant being installed; and Woodchopper Creek, a tributary of the Yukon River, 50 miles above Circle, which has recently been optioned. Two dredges are operating on Gaines Creek, the companies concerned being the Innoko and Flume dredging companies.

Hoist Installed at Maybird

Complete equipment for shaft sinking, including a hoist and compressor, has been installed at Maybird Mining, situated on the west fork of Pine Creek, in the Cœur d'Alene district of Idaho. Operations are under the direction of C. A. Fay, mining engineer, of Wallace, Idaho. The company's plans call for sinking the shaft a total of 250 ft. a day. At present, progress is at the rate of 3 ft. a day, with the face in milling ore.

Geophysics at the Boston Meeting

Papers Presented Discuss Theory and Practice

AT THE recent three-day meeting of the A.I.M.E. at Boston, Aug. 29-31, a partial account of which was presented in *E. & M. J.* of Sept. 8, Dr. C. A. Heiland, of the Colorado School of Mines, Golden, Colo., at the first technical session, presided over by Alfred C. Lane, discussed two papers on the seismic prospecting methods, "Modern Instruments and Methods of Seismic Prospecting" prepared by himself, and "Seismic Method of Mapping Geologic Structures" by Donald C. Barton. These papers represented the first covering of any phase of this subject given at an Institute meeting and furnished everyone with some insight into a subject which has not been widely discussed. In summarizing these papers Dr. Heiland described the usual types of instruments employed, the field equipment used, and the results obtained, illustrating all with lantern slides. Theory and interpretation were also discussed and type structures with the results to be expected from seismic surveys of them were given in some detail. Mathematical discussions were avoided as much as possible at the meeting, although in the papers themselves the authors found it necessary to use more detail.

Agassiz Presides at Second Session

The second technical session was held on the morning of the second day of the meeting with Rodolphe L. Agassiz presiding. The papers for this session were largely confined to magnetic prospecting but included one on seismic methods and another on gravimetric work.

The first paper, "Geophysics and the Mining Engineer," was read in part by Allen H. Rogers, the author. This paper gave in a general way the possible applications of geophysical prospecting as an aid to the mining profession. No attempt was made to describe the various processes or to differentiate between the many different methods now being employed.

Three papers were next presented by H. R. Aldrich. All of these were on the subject of magnetic prospecting and dealt largely with the dip needle, an instrument which has been used to some extent for many years but which has seldom been recognized in its rightful place.

"A Background for the Application of Geomagnetics to Exploration," by Noel H. Stearn, was first presented. This paper discusses magnetic prospecting in a general manner, covering some elementary theories of magnetics, various properties of minerals, terrestrial magnetism and the field of application to geological study. The different kinds of instruments making use of the magnetic properties of minerals in exploring for them are also enumerated. "The Dip Needle as a Geological Instrument," also written by Noel H. Stearn, followed the previous paper in natural sequence. Here one of the several magnetic instruments, the dip needle, was discussed in some detail. This simple instrument and its theory, application and manipulation were most completely presented. To make the paper complete, the solution of an actual problem by these methods was cited and explained. The final paper of this group was, "A Demonstration of the Reflection of Geologic Conditions in Observed Magnetic Intensity," by H. R. Aldrich. This paper followed quite naturally after those of Mr. Stearn and again brought the dip needle to the fore by setting forth several charts of dip needle surveys covering large areas in Wisconsin and explaining the meaning of the readings obtained.

Portable Concentrator to Be Tested in Arizona

A PORTABLE concentrator, mounted on two trucks, for the treatment of ores from small mines, will be tested by Forest Perkins and George Dillard, of Phoenix, Ariz. A 50-ton capacity ball mill has been mounted on a five-ton truck, and two 30-ton Simpson flotation units are carried by an additional Ford truck. A rotary pressure blower is provided for the flotation units. Power for operation will be obtained from the truck motors, which have been provided with oversize radiators.

The partners have already started work on a dump in the Arivaca district that is reported to contain gold, silver, and lead worth $9 a ton.

Dr. Heiland Presents Four Papers

The remaining four papers scheduled for this session were all presented by Dr. C. A. Heiland. "Adaptation of Elastic-wave Exploration to Unconsolidated Structures," by Frank Rieber, was presented simply by title at this time although some of the subject matter was included in Dr. Heiland's general discussion of seismic prospecting at the first session. "Calculations in the Interpretation of Observations with the Eötvös Torsion Balance," by Donald C. Barton, was touched upon only lightly due to lack of time. "Magnetometric Investigation of Gold Placer Deposits," by C. A. Heiland and William H. Courtier, presented a very interesting phase of magnetic prospecting. In addition to a description of the methods employed in surveying placer deposits, emphasis was placed on the geology of the formation of such deposits and the actual results obtained above various types of structures. Finally, Dr. Heiland presented his own paper, "Theory of A. D. Schmidt's Horizontal Field Balance." The description of this instrument was made clear by showing one of the balances and disassembling it in the meeting. The theory of the balance was discussed in some detail and the wide field for its use was pointed out. By simple adjustments the instrument may be used in prospecting for ores of very high magnetic intensities or for searching out oil structures where very sensitive magnetic apparatus must be employed.

Third Session Devoted to Electrical Methods

The third and final technical session of the meeting was held on the afternoon of the second day, Allen H. Rogers presiding. The papers delivered at this time dealt entirely with electrical methods of prospecting and included material of the sort that is absolutely necessary for the continued development of the subject, namely: the results and interpretation of surveys with the tests which prove or disprove the indications.

The first paper, "Electrical Prospecting for Molybdenite at Questa, N. M.," by Karl Sundberg and Allen Nordstrom, was presented by the senior author. A very complete account of this work was given covering the geology of the area being worked, the method employed in prospecting, with some discussion of the theory, the results obtained, the interpretation of the indications, and the checks obtained by trenching, drifting, and raising.

"Operating Principles of Inductive Geophysical Processes" was given by the author, J. J. Jakosky. This paper covers one of the several inductive methods employed in electrical prospecting. Mathematical discussion of the principles involved is avoided to a great extent but the theory underlying the process is covered in some detail with many examples of results to be expected under given conditions. The presentation of the paper was well illustrated with lantern slides of the apparatus employed and was supplemented by two reels of motion pictures showing field parties at work.

The paper which followed this was of especial interest for it disclosed another use to which the electrical methods employed in prospecting may be put, namely, as an aid to the civil engineer. The paper, "Electrical Prospecting Applied to Foundation Problems," by Irving B. Crosby and E. G. Leonardon, was read by the senior author. Actual work done in determining the depth to bed-rock, previous to erection of a large dam, the predicted depth and the drilling results which proved the accuracy of the work in most cases, were recounted. The method employed determines the electrical resistance of the underlying structure and appears to have a wide field of use in erecting foundations and studying tunnel lines.

"Discovery of Salt Domes in Alsace by Electrical Exploration," by G. Carrette and Sherwin F. Kelly, was presented by Mr. Kelly and furnishes another example where determinations of electrical resistance of buried structure

have been made use of, this time in locating salt domes.

Still other examples of results obtained by studying resistances of rocks in the field were covered in "Field Observations in Electrical Resistivity and Their Practical Application," by J. G. Koenigsberger. A short résumé of this paper was given by A. C. Lane, who pointed out the practical importance of such work. The paper itself gives some of the theory involved and specific examples of its use varying from a case where a connection was established between two orebodies to another one where a change in resistivity was found in coal containing gas under high pressure.

The next paper, "Measuring the Variation of Ground Resistivity with the Megger," was presented by Frederick W. Lee, the author. Here again actual examples were given showing how the depth to ground waters and buried structure can be determined by measuring the electrical resistance of the rocks to varying depths. The presentation was well illustrated by slides showing the circuit employed, the results obtained and the manner in which these checked with work done using other circuits and apparatus.

Electromagnetic Prospecting Discussed by Theodor Zuschlag

The final paper of the meeting, "Simplified Theory of Electromagnetic Prospecting," was prepared and presented by Theodor Zuschlag. Here again was a discussion of the theory of inductive methods of prospecting, this time with more emphasis on the mathematics, although this is restricted mainly to elementary calculus. The results to be expected from orebodies under various conditions were discussed and the effects produced by changing the power, frequency and set-up of the primary circuit were gone into in some detail.

At each of the three technical sessions the discussion following the papers was rather limited but this can be accounted for partly because of the intense heat and partly by the unfortunate lack of time allotted to the presentation of so much subject matter. The attendance at the meetings was not so large as had been expected but, after looking over the wealth of material submitted and noting the keen interest in geophysical prospecting as manifested by everyone present, there can be little doubt as to the importance to which this subject has grown within the space of a very few years.

F. Leroy Foster.

E. J. Bumstead Is Freed

E. J. Bumstead, American mining engineer in charge of operations at Humboldt Mining, near Ixtlan, State of Nayarit, Mexico, was released on Sept. 16 by the Mexican bandits who had been holding him captive since Aug. 27, as mentioned in the "Personal" column of *E. & M. J.* last week. The Humboldt company is stated to have paid $10,000 for Mr. Bumstead's release.

J. CARSON ADKERSON

Apologies to Mr. Adkerson and to Philipsburg

J. Carson Adkerson is president of the American Manganese Producers Association and not the secretary, as erroneously stated in the account of the organization's recent convention in Washington that appeared in last week's issue. Mr. Adkerson was re-elected at the meeting to serve another year.

Another error in the same story was caused by the garbling of a sentence which made it appear that Philipsburg, Mont., has been a producer of low-grade manganese ores instead of the high-grade chemical ores that have been characteristic of the camp.

San Francisco Section Discusses Metals

AT ITS meeting on Sept. 6, 1928, the San Francisco section of the A.I.M.E. discussed the commercial movement of metals. E. A. Hersam presided. Herbert Salinger said: "The next few years will see a great change take place in the handling of mine products. The well-managed mine with sufficient ore reserves to warrant the necessary plant installations will increasingly call upon the metallurgist and chemist for the solution of its problems. Shipping sorted ore or concentrates to the nearest smelter will not be the course followed. From ore to metal, or at least to product directly saleable to consumer, will be the practice followed. As a consequence, the mine management will find itself increasingly interested in metal trade problems." Mr. Salinger reviewed the trade movements of zinc and copper, and commented upon the principal sellers of both metals.

H. C. Simpson of the Crocker First National Bank traced the movement of silver from San Francisco to the Orient, commenting on the trade customs peculiar to this metal. He described the Chinese methods of reducing the silver bars and the certification of the product by the King Ku Chu bureau. In closing he commented upon the increase in the use of silver in Africa, which may become an important market.

J. Seaman of American Smelting & Refining commented on the movement of lead ores in the Pacific region. E. Shores also of the American Smelting & Refining discussed the competition between metals and told how copper had displaced lead for certain uses. He also pointed out the need for research to be directed toward the discovery of new commercial uses for lead. C. G. Maier, R. G. Hall, C. E. Williams, E. A. Hersam, and F. J. Girard joined in the discussion.

Lake Superior Institute Elects W. Schacht President

AT THE 26th annual meeting of the Lake Superior Mining Institute, held on Sept. 7 and 8 on the Menominee, Mich., iron range, W. H. Schacht, of Painesdale, Mich., vice-president and general manager of Copper Range, was elected president of the Institute, succeeding C. H. Baxter, professor of mining at Michigan Collge of Mining & Technology, at Houghton, Mich. The meeting was attended by about 200 engineers from Michigan, Minnesota, and Wisconsin. The year just ended has been a most successful one, the treasurer's report showing the largest balance in the history of the Institute—$10,552 on Sept. 2. Among other things, it was voted to hold the next meeting in the Michigan copper district. A book will be published by the Institute containing the biographies of all those who have played an important part in the development of the mining industry near Lake Superior.

A. J. Youngbluth, Ishpeming, Mich., secretary of the Institute since its inception, and John E. Nelson, of Negaunee, Mich., treasurer, were both re-elected. Three vice-presidents were elected for two-year terms, A. Y. Peterson, Duluth; R. P. Zinn, Ironwood, Mich.; and Lucien Eaton, Ishpeming, Mich. Two managers, for two-year terms, also were named, Prof. James Fisher of Houghton and Oliver M. Schaus, Ironwood.

At the technical session, held at Crystal Falls, the following papers were scheduled:

"Color and Luster as a Basis for Concentration," by A. T. Sweet.

"Method of Sublevel Stoping at the Carpenter Mine, Crystal Falls, Mich.," by R. B. Wortley.

"Rapid Method for Determining Sulphur in Iron Ores," by Charles C. Hawes.

"Research at the Michigan College of Mining and Technology," by W. O. Hotchkiss.

"Development of the Pumping of Water at the West Vulcan Mine," by M. J. Schroeder.

"The 'Speed Drift' at the Eureka Mine," by John M. Price.

"Slushing Practice in Michigan Iron Mines," by R. C. Matson.

"Mining Methods and Timbering in Michigan Iron Mines," by R. D. Parks.

"Outline of Flotation," by N. H. Manderfield.

"Safety Methods at the Bristol Mine."

Personal Notes

W. F. BOERICKE, of *Mining and Metallurgy,* was recently in San Francisco.

M. J. ELSING, mining engineer, has changed his residence from Bisbee, Ariz., to Tucson.

MARCUS L. HURLEY, of the engineering staff of the Lewisohn interests, was recently in Butte, Mont.

GEORGE W. PAYMAT is at present treating, by cyanidation, the tailings of the Wagner mine in Trinity County, Calif.

GEORGE HUNTINGTON CLARK, consulting engineer of Birmingham, Ala., has returned to that city after a trip to Brazil.

FRANK C. LORING returned recently to Toronto after an examination of the Fox-Munro property, 9 miles east of Matheson, Ont.

R. A. KINZIE, mining engineer of San Francisco, has returned from Alaska, where he was investigating a water power development.

LORD MELCHETT (formerly Sir ALFRED MOND) is on his way to Canada and will visit the properties of Mond Nickel in the Sudbury district of Ontario.

A. L. CUMMINGS, of the Canadian Department of the Interior, at Ottawa, Ont., has been on a trip to the property of Flintoba Mines, Ltd., in northern Manitoba.

GEORGE H. GARREY, who recently made a geological examination of the Tin Cup mining district in Gunnison County, Colo., is now in Maricopa County, Ariz.

HOMAR L. JOHNSON, assistant editor of *Engineering and Mining Journal,* will leave New York on Sept. 24 for Detroit. Later he will visit the Michigan copper district.

T. P. CAMPBELL, associate professor of metallurgy at the Colorado School of Mines, passed through New York recently on his way back to Golden, Colo., after spending several months in Europe.

J. L. BRUCE, formerly manager of Butte & Superior Mining and now general manager of Cyprus Mines, was in Butte, Mont., recently. Mr. Bruce is spending several months in the United States.

F. J. SIEBERT, mining engineer of Reno, Nev., and consultant to the Consolidated Cortez Silver Mines Company, is temporarily serving as acting manager of the company's property situated at Cortez, Nev.

FRANK AYER, manager of the Morenci branch of Phelps Dodge, has also been placed in charge of the work at Tyrone, N. M., where Phelps Dodge has developed about 12,000,000 tons of low-grade ores.

FREDERIC R. WEEKES has severed his connection with Porcupine Goldfields Development & Finance Company, and has opened an office as consulting mining engineer at 407 Canada Cement Company Building, Montreal, Quebec.

Mrs. SAMUEL H. DOLBEAR, New York State president of the Women's Branch of the Engineers' National Committee for Hoover for President, was recently in Syracuse, organizing a local section of the Women's Branch there.

Dr. R. MELZER, mill superintendent, M. M. Aequator, Sumatra, is in the United States studying flotation practice here. At the Aequator property, Dr. Melzer said that he crosses the equator every time he walks from his office to the mill.

PROFESSOR BAKER, of Queen's University, of Kingston, Ont., has been granted a leave of absence for a year from his duties in the geological department. During his absence, his work will be carried on by DR. SEDAR-HOLM, an eminent Finnish geologist.

DWIGHT E. WOODBRIDGE, of Duluth, Minn., has been elected a director and member of the executive committee as well as directing engineer of Fremont Grant, Inc., and is now in California, beginning minor and preliminary activities on the property.

JAMES JENSON has been appointed superintendent of the Xitinga mines, in the State of Guerrero, Mexico, belonging to the Chontalpan y Anexas Company. A cyanide plant has recently been added to handle tailings from the flotation plant at this Mexican property.

S. POWER WARREN, metallurgical engineer of Golden, Colo., arrived in that city on Sept. 3, to resume his duties as associate professor of metallurgy at the Colorado School of Mines. Mr. Warren had been visiting foreign mining properties during the summer vacation.

J. O. GREENAN, general superintendent of the Consolidated Cortez Silver Mines Company's operations at Cortez, Nev., has left the employ of that company following two years of successful operations. Since leaving Cortez, Mr. Greenan has made several mine examinations in Nevada, and is at present making his headquarters in Reno.

E. M. FOSTER, of New York, is in charge of construction work at the property of Arizona Cinnabar, recently formed by the consolidation of three Arizona quicksilver mines in northern Gila County. A 200-ton treatment plant will be built under Mr. Foster's supervision.

WALTER W. CROZE, mining engineer, of Oliver Iron Mining, delivered an address before the Duluth Engineers' Club on Sept. 17 on the subject of "Manganese Occurrences in Brazil." Mr. Croze has investigated manganese and iron-ore properties in India, Russia, Brazil and Africa, as well as the United States.

OBITUARY

WILLIAM J. CHAMBERLAIN, who was president of the W. J. Chamberlain Ore Company, of Denver, Colo., died on Sept. 8. Mr. Chamberlain was 79 years old, and had retired from active business nine years ago.

JOSEPH GINDELE, mining engineer, who was a graduate of Freiberg University, died at St. Joseph's Hospital, at Nogales, Ariz., after collapsing near his camp at the Twin Buttes mine, Pima County, Ariz. Mr. Gindele had been suffering from an enlarged heart.

IRA WILLIAM FARRAND died at Monrovia, Calif., on Sept. 6 after an illness of two years. He was born Nov. 28, 1888, at Ireton, Iowa, and studied at the University of Wisconsin. He enlisted in the Engineers' Corps in October, 1917, served in France during the late war, and was honorably discharged in April, 1919. His marriage to Eleanor Lillis Farrand in 1920 preceded work on the staff of Cerro de Pasco Copper in Peru. In September, 1926, he contracted tuberculosis while with W. R. Grace & Co. at Oficina Paposa, Iquique nitrate pampa, Chile. The last two years were spent in Arizona and California, a change in climate failing to bring the recovery hoped for. He was buried at the Sunnyside Mausoleum, Long Beach, Calif., on Sept. 8.

FRANK LEWIS NASON, mining engineer and novelist, died at Glens Falls, N. Y., on Sept. 12. Mr. Nason, who had been living at West Haven, Conn., since his retirement, was 72 years old. He was born in New London, Wis., on May 12, 1856, and graduated from Amherst College. Subsequently he became assistant state geologist of New Jersey and of Missouri. In 1894 he was appointed manager of the Columbia River Hydraulic Mining Company, operating in British Columbia. The pursuit of his adopted profession brought him into association, thereafter, with Mt. Wilson Gold & Silver Mining, Derby Lead, Guggenheim Exploration, Ringwood Iron, New Jersey Zinc, and U. S. Steel Corporation. Since 1923 he had been consulting engineer with New Jersey Zinc exclusively. Mr. Nason, in addition to being a mining engineer, wrote several novels, including "To the End of the Trail," "The Vision of Elijah Berl," and "The Blue Goose."

MARKET AND FINANCIAL NEWS

Silver Producers Missing a Chance

By Charles T. Hallinan
London, England

ALTHOUGH the silver market in general is now, of course, quite satisfactory to the producers, it is rather curious that the American Silver Producers' Association, which has wasted five years and considerable energy in a vain attempt to compel Uncle Sam to buy 14,589,730 ounces of silver, under the Pittman Act, for $1 an ounce, has never seen fit to attempt a European propaganda against the illiberal treatment of their metal by European chancellors of the exchequers.

First Great Gritain, then Belgium, today France and Italy, and tomorrow, apparently, Switzerland, have taken, or are taking, steps to reduce the percentage of silver in their subsidiary coinage. In each instance there is expressed a certain amount of public dissatisfaction at receiving "light weight" silver in place of the old familiar solid coin, but in the absence of anything like a concerted defense of the metal, the various European governments have had their way and have thriftily, and quite in the old Tudor fashion, debased their silver coinage and pocketed the proceeds.

An expert in the London bullion market tells me that the tendency has now gone so far that "it is extremely doubtful if a single ounce of the 1928 production of silver will be absorbed in coinage. Actual figures are difficult to obtain, but modern governments, under the present tendency, seem to have on hand ample stocks for their needs. Some of them, like France, are large sellers of surplus silver."

All this is in striking contrast to prewar conditions, when, it is estimated, as much as one-third of the world's annual output went to the mints for coinage.

France, as my informant remarked, is the latest and perhaps most striking example. She not only has all the silver she needs for the new 5-franc and 10-franc pieces which she proposes to issue, but she has a surplus which she is selling in the London bullion market. Only the accident of an unexpectedly heavy demand from the Far East has kept the world price of silver from reflecting this considerable addition to world stocks. On these sales the French Government is making a handsome, and quite effortless, profit of 8 per cent. Under the Poincare Revalorization Act she has declared that the existing silver (as well as gold) coins are no longer legal tender, but she offers to buy all that are presented to the Treasury and the Bank of France at what amounts to 92 per cent of the intrinsic value of the silver.

In Great Britain the process of pinching the silver out of the subsidiary coinage began in 1920, when the British shilling, lineal descendant of the original British pound of sterling silver, was reduced from its fineness of 37/40 pure silver to 20/40. Mr. Churchill this year has still further reduced it, with a net saving to the Treasury from melting and recoinage of approximately $5,000,000. There was considerable public protest; fiscal theories apart, the man in the street is an instinctive bimetallist in the sense that he likes to feel that his silver coins have an intrinsic value approaching their nominal value. This attitude of mind is one which the silver producers might readily have capitalized.

However, they seem to have withdrawn from effective contact with European treasuries and mints, in which respect they are in marked contrast to the aluminum producers, who are pushing their metal vigorously for small token coinage purposes.

The only open market purchases of silver in Europe for coinage purposes today are those of the Vienna mint, which buys from 7,000,000 to 10,000,000 oz. a year for coinage into the "Levantine thaler." Although the word "Levantine" is a popular synonym for roguery, the fact remains that the "Levantine thaler" is almost the only "honest dollar"—in Mr. Bryan's sense of the word—in Europe today. It is 9/10 fine. About 30 per cent of the output is now being re-shipped to Bombay, where it is absorbed into the famous silver hoards of India.

The whole question of the use of silver in subsidiary coinages is now in a state of flux. To a European chancellor of the exchequer, committed to the gold standard or some variant of it, the question is simple enough; he regards silver coinage as "token money," which changes hands at a face value guaranteed by the credit of the state. The less money he wastes on its production, the better for the treasury, in his opinion.

But to the masses of Europe it is not so simple as that. Silver coins, especially the 5-franc pieces of the days of the Latin Monetary Union, are almost the only coins, the only symbols of intrinsic value, which they get hold of. They hoard them on a scale quite rivaling that of India. We are now getting some idea of the extent to which coins are hoarded in Europe by the disclosures in France. That government is now making its fourth consecutive drive to make the French people surrender their stocks of metallic currency and the present stream, so far from being a mere final trickle, is a mighty flood which taxes the physical accommodations of the mint, the treasury, and the Bank of France. It is customary to ascribe this hoarding to the peasants alone, but that, it appears, is wrong. Small provincial shopkeepers have turned up with amazing stores of gold and silver coins. Since this is the age-long habit of the European masses, it would not be very difficult for the silver producers to create a wide popular demand that "the money of the people," as Mr. Bryan called it, shall have as great an intrinsic value as possible. And this, without raising the old dead-and-gone issue of "bimetallism."

Certainly the silver producers would have considerable public support in a campaign for the use of more silver, rather than less, in the European subsidiary coinages. Their argument is a practical rather than a fiscal one. A "debased" silver shilling is much easier to counterfeit than an "honest" silver shilling. Its unfamiliar weight, its puzzling ring on the counter—so different from the ring of the old pre-war currency—makes it difficult, if not impossible, for the man in the street to protect himself from bad money. And as the loss from counterfeiting falls entirely on the public, only rarely on the banks, and never on the treasury, the public's argument for a "square deal" in the subsidiary currencies has considerable strength.

Counterfeiting has enormously increased in Europe since the war, according to articles in the financial press. Europe seems to be going through a period similar to that in the United States right after the Civil War. Paper currency, in particular, is being counterfeited right and left. The British public is now struggling to spot a very skilful counterfeit £1 Treasury note. The public's semi-official instructions are to "note that the signature of 'Fisher' should be wholly below the medallion containing the King's head; turn the note over and examine the clouds above the Houses of Parliament. In the spurious note they are darker and more thundery than in the genuine."

This is very amusing, until you have done it twenty or thirty times!

In short, the popular case for sound silver coinage, in the post-war currencies of Europe, is a stronger case than silver producers appreciate.

Alaska Mine Output for First Six Months of 1928 Declined

STATISTICS of the mineral production of Alaska indicate that for 1928 it will be about the same as last year. For the first half of the year the production is about $500,000 less than for the corresponding period of 1927, but the latter half of the year invariably shows a substantial increase in the gold output from the returns from the dredges, of which several more are operating this year. The production of copper, which is the principal item in the metal output, declined in the first half of the year by $832,132 in value. The decrease in copper production was partly offset by the increase in gold production, which was greater than for the corresponding period of last year by $296,735, and is likely to show an increase for the entire year of about $1,000,000. This increase will result from the greater activity of Alaska Juneau and the new dredging operations of the Fairbanks Exploration company. Production of silver shows decline. Lead is about the same. The returns of tin production are not available till near the end of the year as the production of this metal comes from the area south of Nome and shipments do not go out till the last shipping of the season. The following is the valuation of the different metals as supplied by the Collector of Customs at Juneau for the first half of current year with figures for the corresponding period of 1927:

First Six Months	Gold	Silver	Lead	Copper
1928....	$1,945,544	$153,329	$66,787	$3,654,997
1927....	1,648,809	180,248	67,454	4,487,129

Ontario Gold Production Higher in July

ONTARIO Bureau of Mines reports that July gold production statistics show that during the month 354,342 tons of ore was treated, the recovery being $2,546,743, an average of $7.18 a ton. This is an increase of 16,000 tons treated, and a decrease of $82,000 in production as compared with the preceding months. The Porcupine mines treated 264,134 tons, and recovered $1,576,745, an average of $5.97 a ton. This represents an increase on total production of $100,000, as compared with June. Kirkland Lake mines treated 90,208 tons, and recovered $969,998, an average of $10.80 a ton. This is an increase of 4,000 tons, and a decrease in value of $200,000, as compared with June. The production in June constituted a high record for all time.

As some of the companies publish monthly reports in the press, it is possible to make a very close estimate of the other producers. On this basis it is estimated that the Hollinger mine treated 886,537 tons, an average of 4,925 tons a day, and recovered $5,303,643, during the first six months of the year, as compared with $14,463,173 for the twelve months of 1927. This would indicate a recovery of $6.00, as compared with $6.64 in 1927. The average recovery of McIntyre-Porcupine was $8.18, and of Dome Mines $6.82. Teck-Hughes is now the second largest producing gold mine in Canada, treating in the first six months of the present year, 153,113 tons, or an average of 850 tons a day, and recovering $2,570,932, an average recovery of $16.79 per ton. This compares with the average recovery of $18.04, and a total recovery of $2,775,800 for the entire twelve months of 1927. Lake Shore was the next largest producing mine in the district, with a total recovery of $1,824,398 from ore averaging $13.36. The Wright-Hargreaves recovered $919,782 from ore averaging $7.07 per ton. This is a decrease of $3.00 a ton as compared with 1927, but the tonnage has been increased, and the total production is not far behind the preceding year.

September Dividends Continue to Reflect Copper Improvement

THE total of mining company dividends paid this September is the highest on record for the month. The September, 1927, total is exceeded by $2,173,084, and the total of the preceding quarter month of this year is exceeded by $314,226. Higher dividend rates paid by several copper producers were important factors in augmenting this month's total. Quarterly dividend rates of Tennessee Copper, Utah Copper, and International Nickel are higher by 12½, 50, and 25c. per share, respectively, Isle Royale, Michigan copper producer, posts a semi-annual disbursement of 75c. per share this month, in place of the 50c. payment reported last March.

	1927	1928
March	$27,517,175	$32,299,402
June	34,142,501	33,828,275
September	32,308,142	34,481,226
December	34,512,054	.....
Average	$32,119,968	$33,536,301

No new dividend-paying companies are included in the list this month. Golden Cycle Milling & Reduction Company is the only regular member of the list scheduled to pay a dividend in September from which no word has been received. Most of the changes are accounted for by companies with dividend policies that do not follow the general plan of quarterly payments. However, three small companies—Sidney Mining, Sunshine Mining, and United Gold Mines—irregular payers of dividends, reported disbursements in June that are absent from the list this month.

Though the dividend payment of Hollinger Consolidated Gold Mines reported for this month is at the unchanged rate per share of 10c. every four weeks, notification has been received that, effective with the payment scheduled for October, the rate will be cut in half, to 5c. per share each four weeks. This news is not unexpected, as Hollinger stock quotations have declined steadily since the first of the year. It has been a matter of common knowledge that operating conditions and earnings at the big Timmins producer were not up to expectations, and the unfortunate fire of last February did not tend to help the situation.

E.&M.J. Compilation of Mining Dividends and Yields for September, 1928

Companies in the United States	Situation	Per Share	Total	Per Cent Annual Yield
American Metal	U. S. and Mex.	$0.75 Q	$446,127	6.0
American Metal, 6% pfd	U. S. and Mex.	1.50 Q	150,000	5.4
American Smelting & Refining, pfd	U. S. and Mex.	1.75 Q	875,000	5.1
Bunker Hill & Sullivan, s, l	Idaho	0.75 MX	245,250	7.2
Butte & Superior, z, s	Mont.	0.50 Q	145,099	20.0
California Rand, s	Calif.	0.01 BM	12,800	....
Calumet & Arizona Mining, c	Ariz.	1.50 Q	964,135	4.7
Calumet & Hecla Consolidated, c	Mich.	0.50 Q	1,002,751	6.3
Federal Mining & Smelting, pfd., s. l, z	Idaho, Okla.	1.75 Q	210,000	7.0
Hecla Mining, l, s	Idaho	P. 15 Q	150,000	4.0
Homestake Mining, g	S. D.	0.50 M	125,580	8.0
Inland Steel	Minn.	0.625 Q	739,249	3.7j
Isle Royale, c	Mich.	0.75SA	102,500	5.9j
Mohawk Mining, c	Mich.	1.00Q	115,000	8.8j
National Lead	U. S.	1.25 Q	387,289	4.0
National Lead, pfd. "A"	U. S.	1.75 Q	426,433	4.9
Nevada Consolidated Copper	Nev., Ariz., N. M.	0.375 Q	1,820,666	5.8
Republic Iron & Steel	U. S.	1.00 Q	300,000	5.6
Rico Argentine Mining, s, l, z	Colo.	0.03 Q	24,000	21.4j
St. Joseph Lead, l, s	Mo., N. Y.	0.75 QXX	1,462,821	6.4
Sloss-Sheffield Steel & Iron	Ala.	1.50 Q	150,000	4.9
Tennessee Copper & Chemical	Tenn.	0.25 Q	198,656	4.3j
Texas Gulf Sulphur	Texas	1.00 Q	2,540,000	5.6
Tintic Standard, s, l, z	Utah	0.30 XX	345,874	8.6
U. S. Steel	U. S.	1.75 Q	12,453,411	4.5
United Verde Copper	Ariz.	3.00	900,000	....
Utah Copper	Utah	2.00 Q	3,248,979	3.8j
Companies in Other Countries				
Chile Copper	Chile	0.625 Q	2,759,686	5.2
Hollinger Consolidated Gold	Ont.	0.10 FW	492,000	15.1j
International Nickel, n, c	Ont.	0.75 Q	1,255,038	1.8
Lake Shore, g	Ont.	0.20 QX	200,000	3.6
Lucky Tiger-Combination, g, s	Sonora	0.05 M	33,382	11.9j
McIntyre-Porcupine, g	Ont.	0.25 Q	199,500	4.3
Total			$34,481,226	

s, silver; l, lead; z, zinc; c, copper; g, gold; n, nickel; Q, quarterly; SA, semi-annually; M, monthly; MX, monthly 25c., extra 50c.; BM, bi-monthly; FW, every four weeks; QX, 10c. regular quarterly and 10c. extra; QXX, 50c. regular quarterly and 25c. extra; XX, quarterly 20c. extra 10c.; j based on dividends for past twelve months.

Clay Sales in 1927 Declined in Quantity and Value From 1926

QUANTITY of clay sold by producers in the United States in 1927 amounted to 3,849,176 short tons, valued at $13,697,159, or $3.56 a ton, according to a statement made public by the U. S. Bureau of Mines. These figures show a decrease of 3 per cent in quantity and value compared with 1926. They represent only clay sold as clay, or mined under royalty, and do not include the much greater quantity of clay that was burned into clay products by the producers themselves from their own property.

The five leading clay-producing states in the order of the quantity of clay sold were Pennsylvania with 23.3 per cent of the total quantity, Missouri with 10.8 per cent, Ohio with 8.4 per cent, New Jersey with 8.1 per cent, and California with 7.5 per cent. The data were collected direct from producers or in co-operation with state geological surveys.

The sales of kaolin, the clay that is used in making high-grade pottery and porcelain, as well as paper, oilcloth, and other products, and which is generally considered the highest grade of clay, amounted to 454,245 tons, valued at $3,809,834, an increase of 5 per cent in quantity and 1 per cent in value as compared with 1926. The clay of largest quantity and value is fireclay. The sales of fire clay in 1927 were 2,699,761 tons. This was 4 per cent less than those of 1926, the year of largest sales. The value of the fire clay sold in 1927 was $7,719,725, a decrease of 5 per cent as compared with the value for 1926.

Imports of clay amounted to 394,500 short tons, valued at $3,448,970, a decrease of 19 per cent in quantity and value. Kaolin, or china clay, constituted 86 per cent of the total imports in 1927. Exports of clay in 1927 amounted to 99,384 tons, valued at $1,117,889, an increase of 11 per cent in quantity and 13 per cent in value as compared with 1926. Exports of fire clay amounted to 48 per cent of the total.

Clay Sold by Producers in the United States in 1926 and 1927

Kind	1926 Short Tons	1926 Value	1927 Short Tons	1927 Value
Kaolin	432,215	$3,771,568	454,245	$3,809,834
Ball clay	112,195	867,500	119,763	913,976
Slip clay	8,644	45,959	6,137	32,264
Fire clay	2,819,346	8,119,323	2,699,761	7,719,725
Stoneware clay	84,002	185,288	98,355	203,648
Miscellaneous clay	510,796	1,115,951	470,915	1,017,712
	3,967,198	14,105,589	3,849,176	13,697,159

Copper Import and Export Data of Foreign Countries

DATA supplied by the American Bureau of Metal Statistics summarize copper imports and exports of foreign countries during 1926, 1927, and part of 1928. Figures represent metric tons.

Copper-Importing Countries

	Average Monthly Net Imports		1928 Average Monthly Net Imports	1928 Number of Months Reported
	1926	1927		
Austria	961	1,108	(a)	(a)
Belgium	956	2,012	4,685	6
Czechoslovakia	1,064	1,078	1,002	6
France	9,796	6,727	9,380	5
Germany	10,100	17,704	18,600	6
Great Britain	8,527	9,858	11,837	7
Hungary	720	946	1,185	3
Italy	5,595	5,035	5,338	4
Poland	165	421	793	6
Sweden	1,054	1,054	1,417	6
Switzerland	732	1,072	1,152	7
Japan (b)	1,167	810	680	5
British India	296	122	174	5

Copper-Exporting Countries

Canada	1,388	1,908	3,034	6
Chile	16,156	18,941	20,248	5
Spain	762	920	(a)	(a)
Australia	276	63	421	5

(a) Not yet available; (b) bonded copper not included.

These statistics indicate an improvement in the rate of copper consumption by most of the more important European countries. Likewise, an increase in the rate of production of some of the foreign copper producing companies is indicated by the figures presented in the tabulation.

Sweden's 1927 Production of Iron Ore Makes New Record

THE RECORD figure of 9,660,977 metric tons, an increase of 14 per cent over the 1926 total of 8,465,914 tons, and of 7½ per cent over the 1913 total of 7,475,571 tons, was reached by Sweden's 1927 iron ore output, according to the U. S. Department of Commerce.

The increase is to be attributed to the sale of iron ore to foreign countries, as domestic consumption is considerably less than before the war; exports of iron ore during 1927 reached a new high figure of 10,700,000 tons. Production figures show quite clearly that the Swedish iron ore industry is in process of rapid development, although the condition of the iron and low-grade steel industry is far from good.

During 1927 only 58 of the 126 blast furnaces in Sweden were in operation and the production of pig iron decreased to 417,765 tons from 462,200 in 1926, in spite of a considerable increase in exports. Only foundry pig iron has shown an increase in production and this due chiefly to the utilization of the large blast furnaces at Oxelosund. The decrease in pig iron production as a whole seems to result from a deliberate effort on the part of producers to decrease reserve stocks, which have been considered too large for some time.

Survey of World Zinc Conditions

By International Metal Service, London

Foreign Correspondent of American Zinc Institute

IT is really no source of satisfaction to us to have actual events fulfill and justify our forecasts of dull markets month after month. However, it is a long lane that has no turning, and we feel that the zinc industry is now within sight of the corner. As expected, lead has lifted itself out of the slough of despondency into which it sank and the differential between the selling quotations for lead and zinc in Europe has substantially narrowed, as we feared, albeit the custom for these kindred metals is to fluctuate in close synchronism. But, if nothing else, the advance in lead is commencing to demonstrate the cheapness of zinc, and, unless we badly misread the signs, the truth of this statement will be accepted by the consuming trade very soon. Thus it should occasion little wonder if the approaching autumn does not witness a buying wave for zinc overtopping any previous experience in that section of the market this year. The London market only needs the encouragement of a moderate wave of purchasing for the price of G. O. B. or Prime Western zinc to be lifted at least £1 a long ton.

In the case of lead, slight curtailment of output combined with a normal expansion in world consumption has regulated the situation. Zinc production, in contradistinction, is higher than ever and adjustment of the position is consequently dependent upon an increased consumption alone. Despite the so-called depression in the zinc industry, it will be seen that there has been the normal advance in world consumption of the metal in 1928: therefore, the horizon is brighter now than at any previous time this year, and, so long as the present rate of output is not augmented, the improvement in the statistical situation might reasonably be expected to be reflected in the market ere long.

We estimate world stocks of zinc on Sept. 1, 1928, as follows:

	Metric Tons
United States	40,300
Canada	4,000
Germany-Poland	5,800
Belgium	5,600
France	900
Great Britain	1,100
Scandinavia	200
Other Europe	600
Australia	3,800
Far East	800
Elsewhere	2,000
Total	65,100

DIRECTORS OF THE KEELEY SILVER MINES have decided to pass the semi-annual dividend, which would have been payable Sept. 15. It has been decided to spend $50,000 exploring the lower contact through the lowest workings of the adjoining Mining Corporation of Canada property. The mine is making profits of only $3,000 to $4,000 a month.

The Market Report

Prices of Copper, Lead, Tin Advance, With Huge Sales

New York, Sept. 19, 1928.—In the most broadly active metal market of recent years copper has advanced to 15c. per pound for Eastern deliveries; lead has gone up 10 points to 6½c., New York, and tin has advanced ½c. over the quotation of a week ago. On the other hand, zinc remained quiet and unchanged and silver declined slightly. The activity in the metal market follows renewed assurances of industrial activity in the fall and early winter, though without doubt there has been some speculative demand for forward positions brought about by a feeling among consumers that prices would advance.

Daily Prices of Metals

Sept.	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
13	14.525	47.50	6.40	6.225@6.25	6.25
14	14.525	47.50	6.40	6.225@6.25	6.25
15	14.625	47.50	6.40	6.225@6.25	6.25
17	14.775	47.75	6.50	6.30 @6.35	6.25
18	14.775	47.875	6.50	6.325@6.35	6.25
19	14.775	48.00	6.50	6.325@6.35	6.25
	14.667	47.688	6.450	6.285	6.250

Average prices for calendar week ending Sept. 15, 1928, are: Copper, 14.542; Straits tin, 47.333; N. Y. lead, 6.400; St. Louis lead, 6.242; zinc, 6.250; and silver, 57.625.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis: that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted, and prices at so-called Middle West destinations, 0.325c. above.

Quotations for copper are for the ordinary form of wire bars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Sept.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
13	62 13/16	63 3/8	69	211 7/8	210 5/8	22 1/8	21 7/8	24 9/16	24 3/4
14	63 1/16	63 9/16	69	211 7/8	210 1/2	22 1/16	21 13/16	24 7/16	24 11/16
17	63 1/2	64 1/16	70 1/4	213 3/8	211	22	21 11/16	24 1/2	24 5/8
18	63 9/16	64 1/8	70 1/4	215	212 3/4	22 1/8	21 13/16	24 1/2	24 5/8
19	63 11/16	64 7/16	70 1/4	217 3/4	213 1/2	22 3/16	21 7/8	24 3/8	24 9/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Sept.	Sterling Exchange "Checks"	Silver		Gold London	Sept.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
13	4.84 11/16	57 3/4	26 1/2	84s11½d	17	4.84 5/8	56 7/8	26 1/16	84s11½d
14	4.84 5/8	57 1/2	26 7/16	84s11½d	18	4.84 3/4	56 7/8	26 1/8	84s11 3/8d
15	4.84 5/8	57 1/4	26 5/16	.....	19	4.84 5/8	57	26 1/8	84s11½d
					Avg.		57.208		

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pense per troy ounce of sterling silver, 925 fine. Sterling quoations represent the demand market in the forenoon. Cables command three-eighths cent premium.

Copper Finally Reaches 15c.

After the record-breaking sales reported last week, a considerable tapering off was expected, but it has not occurred, the volume of business in the week ending today being only 2,000 tons less than a week ago. The market was particularly active on Thursday and Friday, which led sellers to advance prices. On Saturday, the c.i.f. market was raised from 15 to 15¼c., by Copper Exporters, Inc., sellers in the domestic market realizing as low as 14¾c. and as high as 15c. for Eastern deliveries on sales made that day. By Monday 15c. was realized by everyone, but buying fell off perceptibly, the total domestic business on Monday and Tuesday being only about a third of that placed Thursday and Friday. One Eastern sale was made at 15⅛c. today, but most orders were booked at 15c. Foreign business, however, has continued unabated, well over 50,000 long tons having already been sold this month, which will probably make September surpass the high total of last May in the export market.

Perhaps 90 per cent of the buying has been for November shipment, with most of the remainder for October, and only an occasional sale for prompt or December. The indications are that September and October requirements are now almost entirely covered, and that November, too, is pretty well taken care of. A pronounced demand for December has risen in some directions, but most producers are as yet unwilling to open their books for that position. Foreign buyers, on the other hand, have an appreciable amount of near-by copper still to purchase, according to the best-informed opinion.

Buying seems to be general, with all classes of consumers coming into the market. In the Middle West, where the price is now 15⅛c., buying has been unusually strong, for both Lake and electrolytic.

Lead Higher in Active Market

With total sales for the week in the largest volume of any corresponding period this year, and a further advance in prices from 6.40 to 6.50c. per pound, New York basis, the lead market is in excellent condition, and under normal conditions would be occupying the center of attention were it not for the tremendous sustained buying wave in copper. Late last week business was unusually active, resulting in an advance in the contract price of the American Smelting & Refining Company from 6.40 to 6.50c. per pound. All sales in the East have been consummated at prices corresponding to the Smelting company's contract price. A large proportion of the week's business has been done in the St. Louis market, where prices at 6.225 to 6.25c. per pound prevailed before the advance and 6.30 to 6.35c. per pound since the advance. The tendency appears to be toward the higher level at the time of writing, with several producers inclined to ask that price for all prompt and forward metal.

Cable manufacturers have been a dominant factor in the large tonnages of lead sold this week. Antimonial and battery lead likewise have been in good demand. October metal has been specified on a large proportion of the week's business. Demand for prompt and late September has been fairly persistent, however, and a considerable tonnage for November delivery has been contracted for, primarily by a few large consumers who appear to feel that it is desirable to satisfy as much of their seasonal requirements as possible at current prices.

Zinc Still at 6¼c.

Zinc sales have improved this week, but remain below normal. The price continues at 6¼c., St. Louis, and sellers are encouraged by the shutdown in the Tri-State district, mentioned in another column, which they feel should help much to strengthen the market. Galvanizers are apparently doing a satisfactory business but holding off the market in the hope of a price reduction, a hope that the sellers of zinc regard as decidedly forlorn. September and October have been the deliveries chiefly specified.

Tin Prices Advance; Market Firm

The market for tin has been consistently strong during the current *E. & M. J.* week, and prices have advanced somewhat since Sunday. The advance in price is explained partly by the strong position of copper and lead, which had a sympathetic influence; and it was partly the result of the expected outcome of recent speculative manipulations in London; and also of the continued strong consuming demand.

Silver Slumps

The silver market experienced a further decline, touching 26 7/16d. in London on Sept. 17, and 56⅝c. in New York on Sept. 17 and 18, the lowest prices quoted since Feb. 6. and 8, respectively. As local rates hold slightly higher than foreign parities, there is very little activity in the market, and sellers are reluctant to make offerings.

Mexican Dollars (Old Mexican pesos): Sept. 13th, 43⅞c.; 14th, 43⅝c.; 15th, 43⅜c.; 17th and 18th, 43c.; 19th, 43⅛c.

Foreign Exchanges Quiet

Closing cable quotations on Tuesday, Sept. 18, were as follows: Francs, 3.90 7/16c.; lire, 5.23⅛c.; and marks, 23.835c. Canadian dollars, ⅜ per cent premium.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c.

Antimony—Per lb., duty paid. New York; Chinese brands, 10⅞c. per lb. for spot, 10⅝c. per lb. for futures. Cookson's "C" grade, spot, 15⅜c.

Bismuth—Per lb., New York, in ton lots, $1.70. Smaller lots, $1.85 and up.

Cadmium—Per lb., New York: 70 @80c., according to quantity.

Iridium — Per oz., $285@$300 for 98@99 per cent sponge and powder.

Nickel—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 37c. (99.9 per cent grade) for single lots of spot metal.

Palladium — Per oz., $42@$44. Small lots bring up to $50.

Platinum—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $78. Dealers and refiners quote the trade for refined metal, per oz., cash, for wholesale lots, $73.50@$74 bid, $75@$76 asked. Nominal.

Quicksilver — Per 76-lb. flask, $126 to $128. Small lots command the usual premiums. Market more active. San Francisco wires $129.33.

Prices of Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten, and Zirconium are unchanged from the issue of Sept. 8.

Metallic Ores

Tungsten Ore—Per unit of WO_3, N. Y.; Wolframite, $10.80@$11; Western scheelite, nominal.

Chrome, Iron, Manganese, Tantalum, and Titanium ores are unchanged from quotations in the Sept. 8 issue.

Tri-State Mines All Down This Week

Joplin, Mo., Sept. 15, 1928

Blende	Per Ton
High	$43.15
Premium blende, basis 60 per cent zinc	$40.00@ 41.00
Prime Western, basis 60 per cent zinc	40.00
Fines and slimes, 60 per cent zinc	36.00@ 39.00
Average settling price, all zinc	39.96
Galena	
High	$85.40
Basis 80 per cent lead	82.50
Average settling price, all lead	82.10

Shipments for the week: Blende, 7,054; galena, 2,631 tons. Value, all ores the week, $497,930.

The shutdown next week will, it is estimated, suspend 90 per cent of the zinc production and will be the most effective restriction of output yet undertaken. It is planned to close down one week of each month, during the remainder of the year, which should limit production to demand.

Platteville, Wis., Sept. 8, 1928.

Zinc Blende	Per Ton
Blende, basis 60 per cent	$42.75
Lead Ore	
Lead, basis 80 per cent	$82.50

Shipments for the week: Blende, 704 tons; lead, 40 tons. Shipments for the year: Blende, 25,650 tons; lead, 1,445 tons. Shipments for the week to separating plans: 1,319 tons blende.

Platteville, Wis., Sept. 15, 1928.

Zinc Blende	Per Ton
Blende, basis 60 per cent	$42.75
Lead Ore	
Lead, basis 80 per cent	$82.50

Shipments for the week: Blende, 682 tons; lead, none. Shipments for the year: Blende, 26,332 tons; lead, 1,445 tons. Shipments for the week to separating plants, 1,311 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, and Tripoli are unchanged from prices in the Sept. 8 issue.

Metallic Compounds

Arsenious Oxide (White Arsenic) —Per lb., 4c. Considerable business reported.

Antimony Oxide, Calcium Molybdate, Copper Sulphate, Sodium Sulphate (Salt Cake), Sodium Nitrate, and Zinc Oxide are unchanged from prices in the Sept. 8 issue.

Alloys

Ferromanganese—Per long ton, domestic and foreign, f.o.b. furnace or duty paid, port of entry, $105 quoted for last half, 1928. Spiegeleisen, 19@21 per cent, $33 f.o.b. furnace.

Nickel Silver—Price advanced from 29¾ to 30c. per lb. for 18 per cent nickel Grade A sheets, effective Sept. 17.

Yellow (Muntz) Metal—Price advanced from 20¼ to 20½c. per lb. for dimension sheets, and from 17¼ to 17½c. per lb. for rods, effective Sept. 17.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon. Ferrotitanium, Ferrotungsten, Ferrovanadium and Monel Metal are unchanged from prices in the Sept. 8 issue.

Rolled Metals

Copper Sheets—F.o.b. mill, price advanced from 23½ to 23¾c. per lb. for sheets, and from 16⅜ to 16⅝c. per lb. for wire, effective Sept. 17.

Lead and Zinc Sheets are unchanged from prices in the Sept. 8 issue.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of Sept. 8.

Iron, Steel, and Coke

Iron—Per gross ton, Valley furnaces, Bessemer, $17@$17.50, basic, $16@$16.50; No. 2 foundry, $16.75@$17.

Steel—Base prices per gross ton, Pittsburgh, billets and slabs, $33; plates, structural shapes, and soft steel bars, per lb., 1.90@2c.

Coke—Per gross ton, Connellsville furnace, contract, $2.75@$3; spot, $2.50@$2.75. Connellsville foundry, contract, $3.50@$4.85; spot, $4@$4.85. By-product coke, Ohio and Kentucky, $7; Buffalo and Detroit, $8.50@$9.

Mining Stocks—Week Ended Sept. 15, 1928

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	79¼	74¼	79¼	Jl.14, Au. 20 Q	1.00
Aris. Com'l	Boston	5½	5	5½	Jl. 16, Jl. 31 SA	0.25
Cal. & Aris	New York	112½	103¾	112½	Se. 7, Se. 24 Q	1.50
Calumet & Hecla	Boston	33½	31½	32½	Au. 31, Se. 15 Q	0.50
Cerro de Pasco	New York	93½	80	93½	Jl.12, Au. 1 Q	1.25
Chile Copper	New York	53½	48	52¾	Se.15 Se.29 Q	0.62½
Con. Coppermines	N. Y. Curb	12	11	11		
Copper Range	Boston	23	20¾	22½	Mr. 24, Ap. 20 A	1.00
Crystal Copper	Boston Curb	*35	*33	*35		
East Butte	Boston	2½	2½	2½	Dec., 1919	0.50
Granby Consol	New York	61½	58¼	61¼	Jl.13, Au.1 Q	1.00
Greene Cananea	New York	125½	117½	122¾	Se. 14, Oc.1 Q	1.00
Howe Sound	New York	60¾	58½	60	Je.30, Jl.16, Q	1.00
Inspiration Consol	New York	25¾	24½	24¾	Apr. 1927 Q	0.25
Isle Royale	Boston	22½	20¾	21¾	Au.31, Se.15 SAX	0.75
Kennecott	New York	99¾	97½	99	Au.31, Oc 1 Q	1.50
Magma Copper	New York	62½	58½	61½	Jl.29, Jl.16 Q	0.75
Mason Valley	N. Y. Curb	1⅛	1⅛	1⅛		
Miami Copper	New York	22	21¼	21¾	Au.1, Au.15, Q	0.37½
Mohawk	Boston	56½	42	51	Jl. 31, Se. 1 Q	1.00
Montana-Idaho	Spokane	*13½	*11½	*11½		
Mother Lode Coal	New York	2½	2½	2½	Je.8, Je. 30, SA	0.15
Nevada Consol	New York	26⅛	25¼	26	Se.14, Se.29 Q	0.37½
New Cornelia	Boston	30	29¼	29¼	Au.3, Au. 20 Q	0.50
Noranda	N. Y. Curb	57½	51½	51½		
North Butte	Boston	5½	4⅜	5½	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*74	*68	*74	Sept., 1926	0.03
Old Dominion	Boston	16⅜	15	15½	Dec., 1918	1.00
Phelps Dodge	N. Y. Curb	155	145	155	Se.10, Oc.1 Q	2.00
Quincy	Boston	47	42	43¾	March, 1920	1.00
St. Mary's Min. Ld	Boston	31¾	30	31	Ap.1928 A	2.00
Seneca Copper	New York	3¼	2¾	2¾		
Shattuck-Denn	N. Y. Curb	16⅜	15½	15½		
Tenn. C. & C	New York	14¾	14	14	Au., 31 Se.15,Q	0.25
United Verde Ex	N. Y. Curb	16	14¼	16	Oc.6, No.1 Q	0.50
Utah Copper	New York	175½	175½	175½	Se.14, Se.29 Q	2.00
Utah Metal & T	Boston	1⅛	1⅛	1⅛	Dec., 1917	0.30
Walker Mining	Salt Lake	1.35	1.27½	1.35		
NICKEL-COPPER						
Internat. Nickel	New York	133¼	123¾	127½	Se.10, Se.29 Q	0.75
Internat. Nickel pfd	New York	114	112	114	Jl.12, Au.1 Q	1.50
LEAD						
Gladstone Mtn	Spokane	*3½	*3½	*3½	June, 1927	0.005
National Lead	New York	131½	126	130	Se.14, Se.29 Q	1.25
National Lead, pfd. A	New York	142½	142½	142½	Au.31, Se.15 Q	1.75
National Lead, pfd. B	New York	120½	120½	120½	Oc. 19, No.1 Q	1.50
St. Joseph Lead	New York	47½	44¾	44¾	Je.9, Je.20, QX	0.75
ZINC						
Am. Z. L. & S	New York	34⅞	29⅜	33	May, 1917	1.00
Am. Z. L. & S. pfd	New York	93½	88¼	91	Nov., 1920	1.50
Butte C. & Z	New York	9⅜	8½	8⅜	De., 1926	0.50
Butte & Superior	New York	11½	11	11	Se.14,Se.29 Q	0.50
Callahan Zn-Ld	New York	3	2⅜	3	De., 1920	0.50
Consol.Lead&Zinc 'A'	St. Louis	13½	12¼	12½	Je.25, Jl.1 Q	0.25
Eagle-Picher	Cincinnati	19	17¼	18⅜	No.15, De.1 Q	0.40
Eagle-Picher pfd	Cincinnati	...	...	100	July 15 Q	1.50
Evans-Wallower	N. Y. Curb	7¼	6¾	7		
New Jersey Zn	N. Y. Curb	225	220	222½	Jl. 20, Au. 10 X	2.00
Treadwell-Yukon	Toronto	15¾	14¼	14½		
United Zinc	N. Y. Curb	*60	*60	*60		
Yellow Pine	Los Angeles	*25	*25	*25	Dec., 1925 QX	0.04
GOLD						
Alaska Juneau	New York	4⅞	4	4		
Ankerite	Toronto	*25	*22	*22		
Barry-Hollinger	Toronto	*57½	*45	*46		
Central Manitoba	Toronto	1.00	*95	1.00		
Cresson Consol. G	N. Y. Curb	*99	*82	*91	Je.30, Jl.10 Q	0.10
Dome Mines	New York	10	8¾	9½	Se.29, Oc.20 Q	0.25
Gold Hill	Toronto	*13	*11	*13		
Golden Cycle	Colo.Springs	†1.64	†1.63	...	My. 31, Je.10 Q	0.04
Hollinger Consol	Toronto	9.05	8.30	8.45	Se.19, Oc.6 M	0.05
Homestake Mining	New York	75	74	74	Se.2, Se. 20 M	0.50
Kirkland Lake	Toronto	1.61	1.50	1.51		
Lake Shore	Toronto	22.50	22.30	22.50	Se.1, Se.15, QX	0.20
McIntyre Porcupine	New York	21¾	21¼	21¼	Au.1, Se.1 Q	0.25
Portland	Colo.Springs	†*20	†*18	....	Ap., 1927	0.02
Rand Mines	New York	...	...	39½	Au.21-28 Am.Sh	1.52
Sylvanite	Toronto	3.05	2.60	2.60		
Teck-Hughes	Toronto	9.15	8.85	8.90	Jl. 17, Au. 1 SAX	0.15
Tom Reed	Los Angeles	*59	*55	*59	Dec., 1926	0.02
Tough-Oakes	Toronto	*45	*33	*35½		
Vipond Cons	Toronto	*62	*54	*56	April, 1927	0.03
Wright-Hargreaves	Toronto	3.40	3.09	3.15	Jl.16, Au.1 Q	0.02½
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	22	20¾	21		
Con. Cortez	N. Y. Curb	*22	*22	*22		
Dolores Esperansa	N. Y. Curb	1	*91	*92	July, 1923	0.05
N.Y. Hond's Rosario	N. Y. Curb	...	...	15	Jl.18, Oc.28 Q	0.50
Premier Gold	N. Y. Curb	2⅛	2⅛	2⅛	Se.14, Oc.4 Q	0.06
Tonopah Belmont	N. Y. Curb	*88	*88	*88	Oc., 1925	0.05
Tonopah Extension	N. Y. Curb	*9	*5	*5	Ap., 1925	0.05
Tonopah Mining	N. Y. Curb	4¼	4	4	Mar.31,Ap.21 SA	0.07½
West End Consol	N. Y. Curb	...	...	*4	Mar., 1923	0.05
Yukon Gold	Boston Curb	*74	*55	*74	June, 1918	0.02
SILVER						
Beaver Consol	Toronto	*99	*90	*99	May, 1920	0.03
Castle-Trethewey	Toronto	*42½	*39	*39		
Coniagas	Toronto	...	...	4¼	May, 1924	0.12½
Keeley	Toronto	*42	*39	*41	Mr.1, Mr.15 SA	0.04
Lorrain Trout Lake	Toronto	...	...	*50	July, 1925	0.05
Mining Corp. Can	Toronto	3.40	3.20	3.30	My.20, Je.13 SA	0.125
Nipissing	N. Y. Curb	3¼	3⅛	3¼	Se.29, Oc.20 Q	0.075

Stock	Exch.	High	Low	Last		Last Div.
SILVER-LEAD						
Ahumada	New York	3¼	3	3¼	Ap., 1927	0.12½
Bingham Mines	Boston	48½	42	43	Se.20, Oc.5 Q	0.50
Bunker Hill & Sullivan	N. Y. Curb	126	125½	126	Au.31, Se.4 MX	0.75
Cardiff M. & M	Salt Lake	*52	*50	*50	Feb. 5, 1927	0.10
Chief Consol	Salt Lake	3.50	3.50	3.50	Ja.10, Fe.1 K	0.10
Consti'n Mng.&Mill'g.	Spokane	*35	*24	*25		
Erupcion	Boston Curb	*22	*20	*20	Dec. 13, Jan. 3,	0.07½
Eureka Lily	Salt Lake	1.70	1.35½	1.70		
Federal M. & S	New York	....	....	135	Je., 1927	10.00
Federal M. & S. pfd	New York	102½	100¼	100¼	Au. 24, Se. 15 Q	1.75
Golconda	Spokane	*91½	*85	*85		
Hecla Mining	N. Y. Curb	15½	15	15	Au.15, Se. 1 Q	0.15
Highland-Surprise	Spokane	*10	*9	*9½		
Iron King Mining	Salt Lake	*82	*80	*80		
Keystone Mining	Salt Lake	*27	*20	*24	Fe., 1926	0.07½
Lucky Jim	Spokane	*26½	*24	*25		
Lucky Tiger-Com	Kansas City	†6.85	†6.65	....	Se. 6, Se. 20	0.05
Mammoth Mining	Salt Lake	1.40	1.40	1.40	De., 1926	0.25
North Lily	Salt Lake	7.85	7.75	7.80		
Park Utah	New York	10¾	10½	10½	Se., 11, Oc.1 Q	0.20
Plutus Mining	Salt Lake	†2.00	†1.55	....	Ap.10, Ap.16 Q	0.10
Rico-Argentine	Salt Lake	*44	*43	*43	June 15 Q	0.03
Sherman Lead	Spokane	*22½	*21	*21		
Silver King Coal	Salt Lake	13.25	13.25	13.25	Se.20, Oc.1 Q	0.25
Silversmith	Spokane	*10½	*9	*10	Oct., 1926 Q	0.02
Strattons Mines	Spokane	1.41	1.25	1.41		
Sunshine M. Co	Spokane	1.40	1.38	1.38	June 20, K	0.02
Tamarack-Custer	Spokane	*39½	*35	*35½	Sept., 1924	0.25
Tintic Standard	Salt Lake	14¼	14	14	Je.18, Je.30 QX	0.30
Utah-Apex	Boston	4½	4	4	Jl.14, Au.1 K	0.25
IRON						
Bethlehem Steel	New York	67¾	63	67¾	Jl., 1924	1.25
Cleveland-Cliffs Iron	Cleveland	140	122	135	Jl.14, Jl.25. Q	1.00
Colorado F & I, pfd	New York	65¾	64	65	Au.10, Au.25 Q	2.00
Gt. North'n Iron Ore	New York	22¾	22¾	22¾	Ap. 9, Ap. 30 K	0.75
Inland Steel	New York	70	67¾	68	Au. 15, Se.1 Q	0.62½
Republic I. & S	New York	91¼	72	88¾	Au. 14, Se. 1 Q	1.00
Republic I. & S. pfd	New York	109	107½	108½	Se. 15, Oc. 1 Q	1.75
Sloss-Sheffield S. & I	New York	121	118	121	Se.10, Se.20 Q	1.50
Sloss-Shef. S.&I. pfd	New York	...	...	111½	Se. 20, Oc. 1 Q	1.75
U. S. Steel	New York	159¾	154	159	Au.30, Se.29 Q	1.75
U. S. Steel, pfd	New York	142	141	142	Au. 6, Au. 30 Q	1.75
Virginia I. C. & C	New York	....	....	27	Jan., 1924	1.50
Virginia I.C.&C. pfd	New York	....	....	50	Je. 16, Jl. 2 SA	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN						
De Beers Consol	New York	....	....	26	Ju.16, Ju.26 K	0.97
So. Am. G. & P	N. Y. Curb	4	3¾	4		
Alum. Co. of Amer	N. Y. Curb	150¾	137	148½		
Alum. Co. of Amer. pf.	N. Y. Curb	108½	108½	108½	Se. 15, Oc. 1 Q	1.75
Vanadium Corp	New York	83¾	80	83¾	Au. 1, Au. 15 Q	0.75
Patino M. & E	New York	34¼	32¾	33¾	April, 1928	4s.
ASBESTOS						
Asbestos Corp	Montreal	28¾	28	28½	Jan., 1926	1.50
Asbestos Corp. pfd	Montreal	90	89	90	Jl. 30, Jl. 16 Q	1.75
SULPHUR						
Freeport Texas	New York	69½	61½	67¾	Jl.14,Au.1 QX	1.75
Texas Gulf	New York	73¾	70⅜	73	Se. 1, Se 15 Q	1.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	49¾	48	49¾	Au. 21, Se 1 Q	0.75
Amer. Metal, pfd. 6%	New York	...	...	113	Au.15, Se.1 Q	1.50
Amer. Sm. & Ref	New York	253¾	243	250	Jl 13, Au.1 Q	2.00
Amer. Sm. & Ref. pfd	New York	136	136	136	Au. 3, Se. 1 Q	1.75
Consol. M. & S	Montreal	272	265	268	Je.30, Jl.16 SAX	6.25
Newmont Mining	N. Y. Curb	167	163	164¾	Je.30, Jl.16 Q	1.00
U. S. Sm. R. & M	New York	49¾	49	49¾	Jl. 5, Jl. 14 Q	0.87½
U.S. Sm. R.&M. pfd	New York	54¼	54	54¼	Jl. 5, Jl 14 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. A, Annual. SA, Semi-annually. M, Monthly. FW, four weeks. K, irregular. I, Initial. X, Extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

LONDON QUOTATIONS—WEEK ENDED September 4, 1928

Name	High	Low	Last	Date	Amount	Last Div.
Alaska Mexican ($5)	35/6	25/—	35/—			
Alaska Treadwell ($25)	120/6	120/—	120/—	Nov., 1926	4 (d)	
Aramayo Mines (25 frs.)	60/7½	57/6	60/—	May, 1928	5 p.c. (†)	
Burma Corpn. (10 rupees)	14/6	14/—	14/3	Aug., 1928	6 annas*	
Bwana M'Kubwa (5s)	8/1½	7/4½	7/9			
Camp Bird (2s)	3/6	3/—	3/3	April, 1928	16¾ p.c.	
El Oro (£1)	4/7½	3/9	4/6	Nov., 1924	2½ p.c.*	
Frontino & Bolivia (£1)	11/3	10/—	10/—	July 1928	3¾ p.c.	
Mexican Corpn. (£1)	10/—	9/7½	9/9			
Mexico Mines of El Oro (£1)	24/4½	19/6	22/6	Dec., 1926	3¾ p.c.*	
Mond Nickel	97/6	90/—	96/3	Aug., 1928	20 p.c.	
N'Changa Copper Mining	19/9	18/6	19/—			
Oroville Dredging (£1)	4/—	3/6	3/9	Dec., 1923	3¾ p.c.	
Rhodesian Congo Border (£1)	30/7½	29/4½	30/—			
St. John del Rey (£1)	11/9	11/7½	11/9	April, 1928	7½ p.c.	
San Francisco Mines (10s)	28/6	27/6	28/—	July 1928	12½ p.c.	
Santa Gertrudis (£1)	14/6	14/3	14/3	July 1928	7½ p.c.	
Selukwe (2s. 6d.)	10/9	9/1½	9/9	April, 1917	6¾ p.c.	
S. Amer. Copper (2s.)	65/7½	60/7½	64/4½	July 1928	5 p.c.	
Tanganyika (£1)	2/3	2/—	2/1½	Nov., 1917	75 p.c.	
Union Miniere de Haut-Katanga (Brussels)	11,740	11,500	11,675	July, 1928	182.60 (‡)	

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian frs. and free of taxation.